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THE OXFORD SCHEME OF NATURAL SCIENCE*

ALL true lovers of English science, we might say all discerning lovers of their country, must have watched with anxious interest the efforts which in these latter times a few able and energetic men at each of our ancient universities have been making to strengthen and widen the study of Natural Science in those so-called seats of learning; and must have admired the zeal and wisdom with which they have fought against the stubborn resistance of the powers that be. To all such the recently-issued programme of the Board of Natural Science Studies at Oxford will have particular interest; for upon the wisdom of the regulations introduced by that Board will depend in great measure the future of Natural Science at Oxford.

In calling attention to this programme we shall so far rely on our well-known admiration of the talents and energy of the members of the Board as to take leave to say nothing of its good points. These will be read and known of all men who love science; and the results of the scheme, as far as its good features are concerned, will be the reward of its framers, whether, as we hope, they succeed in establishing Natural Science at Oxford in its proper dignity and power, or whether, as we fear, they eventually succumb to all those many influences which seem slowly but surely to be pressing the life out of both Oxford and Cambridge.

We think we shall be best furthering the interests of Science if we content ourselves with pointing out the blots of the scheme, blots which stand out in the stronger relief the more one dwells on what ought to be its immediate results, viz., the destruction of mere cram-work and the encouragement of the spirit of original research.

We learn that the student who wishes to take honours in Natural Science, must undergo a previous examination in the elements of Mechanics, Physics, and Chemistry. We have no remark to make on this, except to suggest that if the elements of Biology had been added, matters would have been vastly simplified, and much of the confusion to which we shall have presently to refer entirely done away with.

Having passed this previous examination, the student may elect to be examined in either Physics, Chemistry, or Biology, with or without certain special subjects, such as Geology, Zoology, or Botany.

Touching the examination in Physics we will simply express our regret that there is no definite statement that the examination in this branch will be partly of a practical kind. This is of course intended, but it is not specially stated. If the distinguished Oxford Professor of Experimental Physics knew what hard work his friends had to persuade the world that his superb laboratory is a real honest workshop, and not a gorgeous palace and magnificent show-room, he would have had the instructions touching the practical part of the examination in Physics printed in capitals or italics rather than omitted altogether.

* Notice of the Board of Studies for the Natural Science School of the University of Oxford, 1872.

With regard to the Chemistry we will only remark that the restriction of the practical part of the examination to the old-fashioned inorganic analysis seems to us to mark an opportunity lost. Is the detection and estimation of a base and an acid for ever to remain the be-all and end-all of practical chemistry? We trust not. A change in this respect must soon take place in our examining bodies, and Oxford might have led the way.

It is to the biological part of the scheme that we desire more particularly to call the attention of our readers. The student who wishes to go out in Biology may take the general subject of Biology either alone or together with certain restricted special subjects, such as Comparative Osteology, Ethnology, &c., or together with either of the larger special subjects, Zoology, Botany, and Geology. The general subject of Biology comprises General and Comparative Anatomy and Histology, both animal and vegetable, Human and Comparative Physiology, with Physiological Chemistry, and "the general philosophy of the subject." Our readers will naturally wonder what is meant by this last heading. They probably have been accustomed to consider that science is philosophy, and that the philosophy, for example, of comparative anatomy, grows out of the facts organically, is borne by the subject as plants bear flowers and fruits, and cannot be pinned on, like an artificial blossom on a garland, either in an examination or elsewhere. The mystery disappears when we turn to the list of books recommended (about which we shall have a word to say), where we find under the head of Genera Philosophy Agassiz' "Classification" and Whewell's "Inductive Sciences." Evidently the Board desires to try the students as the saints of old were tried in order to be made perfect; they tempt them with courses of evil reading to see whether the truth be in them or no. But to return: the scheme, as it stands at present, does very well for a man who goes in for the general subject of Biology on the strength of his acquaintance with the contents of the Oxford Museum, and his knowledge of that Physiology falsely so called which is built up on a comparison of the organs of one animal with those of another. The practical examination in dissections and histological preparations will most likely fairly test his proficiency in these matters, and if he takes up one of the minor special subjects he will probably have a good but limited idea of one particular series of facts, *e.g.*, the various forms of stomach presented by the animal kingdom. We doubt very much if the examination and preparatory course of study will have helped to make him a fruitful man of science, working in and for ideas. Probably the reverse.

But how much better off is he than the poor botanist who goes to seek at Oxford the means and help to make a working man of science of himself. He must first go through the general examination in Biology, must cram up text-books on Human Physiology, must read up all the futilities of the modern animal histologists, and dabble in the speculations of physiological chemists, to say nothing of his knowledge of the exoskeleton of the Arthropoda and other bits of special animal morphology, before he can turn to his heart's desire, the classification of Phanerogams. And he will cram; that will be the inevitable result.*

* The prolixity of some members of the Board seems to have driven the framer of the section of Botany into the opposite extreme. We cannot think it intended that the examination in Botany should be so feeble as the programme seems to intimate.

Hardly better off is the physiologist, properly so called. What he needs as general education is a thorough knowledge of physics and chemistry, with a general acquaintance with the fundamental laws and simpler facts of animal morphology. Instead of that, this scheme takes him away from physics and chemistry, and tries to smother him with the specialities of morphology, to which he most probably has a decided natural repugnance.

Worst off of all is the geologist, who has to go in for all three general subjects before he can make his special knowledge weigh with examiners, and who therefore will be induced to keep on cramming heterogeneous knowledge up to the last moment; forasmuch as the statutes tell him that his place will depend "*on the joint result of his examination in all his subjects.*"

In our humble opinion it would have been far better to have made the previous examination to include the elements of Biology, and at the same time rather more searching as a whole. Every science scholar would then have known something of everything essential in Natural Science. Freed by this examination, he might have turned at once to that something of which he ought to know everything—to Geology, to Botany, to Animal Morphology, to Physiology, to Chemistry, to Physics. He would thus have, on the one hand, a sound foundation, with an insight into "the general philosophy," properly so called, of all science, and by early training in a special branch would have had his face set towards original work. We have no space left to criticise the various items of the special directions under Biology, Geology, &c.; but we cannot refrain from uttering our protest against the pernicious habit, carried to an excess in this programme, of recommending particular books for study. This always means "particular books for examination," and is the most potent nurse of cram. Nor is the evil mended much by making the list of books large and long; for rather another evil is then introduced, viz., that of giving authoritative sanction to bad books. We venture to assert that no man of science can look through the list of books appended in this programme to his own particular line without being compelled to admit that some of the books recommended are essentially bad. We have spoken freely because the matter is one we have at heart. We must confess that the scheme at Oxford, as it stands at present, is inferior to that at Cambridge (excepting always that fearful system of order of merit, which hangs like a millstone round all Cambridge studies), and decidedly inferior to what the scientific examinations of the University of London will be when some necessary changes have been made in its B.Sc.

MÄDLER'S HISTORY OF ASTRONOMY

Geschichte des Himmelskunde, nach ihrem gesammten Umfange, von Dr. J. H. von Mädler, Emeritirtem Professor und Director der Sternwarte, Dorpat. I Band, i. ii. iii. Lieferungen. (Braunschweig, 1872. London: Williams and Norgate.)

A PERIOD when the love of astronomical study—long confined to a few select votaries, and dormant in general estimation—has attained an unprecedented and unlooked-for diffusion, is well suited for the appearance of such a historical view of the subject as may not only form a book of reference and comparison for the more advanced cultivator of the science, but may commend itself to the less instructed student, as well by the accuracy of its statements as by the perspicuity of its views and the simplicity of its expression. The work of which the earlier portion is now lying before us, seems, as far as can be foreseen, well calculated to answer this end, and Germany may be congratulated upon the commencement, at least, of what, ere long, ought to be made popularly accessible among ourselves. We possess, indeed, already, in the "History of Physical Astronomy," by Prof. Grant, a work of the highest pretension as to accuracy and intelligence; but the subject is there regarded from a different point of view, and treated in a different manner, and there is abundant room for each of them.

For those who venerate the Observatory of Dorpat, from the high position which it took and maintained under the elder Struve, as well as for those who love to contemplate and examine in detail the wonderful features of our satellite, this work will possess a double interest, both as originating within the walls of that honoured building, and as proceeding from the pen of the leading selenographer of his own time. It is only to be hoped that the advancing years of the venerable author may not interrupt the progress of what has been so auspiciously begun. At present it has been carried only as far as the establishment of Tycho *de* Brahe, as it seems to be the inaccurate custom of the Germans to call that great man, in his island of Hween, where "lived the Prince of Astronomy in external fitness, with princely aspect and splendour." But before the science had attained this due recognition as worthy of royal patronage and aristocratic cultivation, it is needless to say that it had to pass through long periods of darkness and discouragement and difficulty, when its progress was retarded by superstitious bigotry, chilled by heedless indifference, or entangled by the substitution of imaginary hypotheses for the patient labour of protracted investigation; and in tracing through all these impediments its gradual and interrupted advance, the learned author has shown not only a full command of the subject, but great fairness and discrimination in its treatment; and if it might be hinted that the style is sometimes encumbered by a repetition of unvaried metaphors, yet it is always perspicuous and pleasing. The only point as to which positive censure would not be invidious is no fault of the author, but of the corrector of the press, who must be held answerable for some offensive errata in the Greek and Latin citations. For errors in English and Welsh, through which Bradley's benefices of Bridstow, in Herefordshire, and Llanddewi-velvre, in Pembrokeshire, appear as "Bradstone" and "Welfric," some intermediate authority must be responsible; but we may fear that our own rendering of German names is not invariably more accurate. In order not to interrupt the current of the history, much of the biographical matter appears in the form of notes at the foot of the page, frequently of especial interest; we feel, however, the want of occasional references. The intensity of the author's annoyance at the monkish system may possibly lead some readers to an occasional smile; but with the Papacy as a whole no religious difference has prevented him from dealing with the candour and justice of a true historian. Of Pliny's merits he has formed a very unfavourable judg ment, and from this or some other cause, has not noticed a passage in that writer which seems to have been singularly overlooked, but which nevertheless possesses a certain degree of interest. It has been invariably asserted that Hipparchus was incited to the formation of his celebrated catalogue by the appearance of a new star, leaving it to be inferred that it was an object similar to the Great Star of 1572 (the possible return of which, by the way, Baron von Mädler refers to 1885, instead of the present year, as has been sometimes thought), or that of 1604. But it seems to have altogether escaped notice that the words of Pliny in reference to it expressly describe a movement which must have placed it in another class of bodies:—"Novam stellam et aliam in ævo suo genitam deprehendit: ejusque motu, qua die fulsit, ad dubitationem est adductus, anne hoc sæpius fieret, moverenturque et eæ, quas putamus affixas." Such is his statement; where he obtained it of course cannot now be ascertained; but from its explicitness it certainly carries at least a show of authority.

In adopting a more favourable idea of Ptolemy than has been admitted by many opponents of his system, the author has expressed an opinion well deserving of attention:—"When criticising the literary proceedings of Ptolemy, we should not forget how extremely different, as compared with our own, was the form which the mutual relation of authors took in those days. Instead of the hundreds of thousands, or even millions, of books which fill our libraries and catalogues, their number at that time might hardly amount to a thousand; the principal works especially were so few in number that every one, generally speaking, who read and wrote was acquainted with them. Ptolemy wrote for his own time. When he alleged anything which was the property of another without mentioning his name, nobody could then have been well deceived by it, and there could be no reasonable question of a design of plagiarism." And as an incidental parallel he remarks the use made in a similar manner by St. Paul of the expressions of Archias and Epimenides.

Some interesting, but perhaps not generally known, facts may find a suitable place in the present brief notice; such as the discovery on the site of what is conjectured to have been Cicero's house at Rome of a sun-dial, which may have been the identical one mentioned in one of his letters; the employment, in Seneca's time, of hollow glasses filled with oil to protect the eye in observing solar eclipses; the grandeur of speculation which led Cleomedes, some fifteen centuries ago, to assert that the earth would show but as a point to the sun, and from the fixed stars, even if it possessed intrinsic light, would be imperceptible; the discovery in Egypt, in 1854, of four wooden tablets covered with plaster, containing astronomical calculations—the almanac, in fact, of the great school of Alexandria in the reigns of Trajan and Hadrian; the recognition of Uranus by the ancient inhabitants of Tahiti. Relations such as these lend an additional interest to a narrative which, even without them, would not be felt as dry or tedious.

One more passage may be cited, as giving full evidence of that soundness of thought and feeling which thus (but not thus only) are shown to be united in the Baron von Mädler with the other qualifications of a historian:—

"If in those times a comet appeared, writings appeared immediately, especially in the form of religious exhortations, taking occasion from it to recommend repentance and amendment. Let no one suspect that we have even the slightest objection to offer to these admonitions. Much rather could we wish that at other times also, whether a comet were visible or not, they were employed with equal earnestness, and that the inscription on a comet medal of that date (1472)—

God grant us from this comet-blaze
To learn amendment of our ways—

were more laid to heart, especially as regards the second line. If cometary prediction had brought nothing worse to light than exhortations to amendment, we might with respect to this fancy (though the fancy itself, as such, would always remain objectionable) have been able to contemplate the whole with greater satisfaction."

T. W. WEBB

OUR BOOK SHELF

Botany for Beginners: an Introduction to the Study of Plants. By Maxwell T. Masters, M.D., F.R.S. (London: Bradbury, Evans, & Co., 1872.)

THIS is in no sense a cram-book. To take the trouble of learning it by heart, page for page, would not suffice for any botanical examination with which we are acquainted. This is a great advantage in an elementary scientific work. Not only does it enable the author to be entirely independent of the favourite points of particular examiners; but it permits him to pursue his own method of developing the subject in the learner's mind. In no science is this freedom of greater value than in botany. The text-books used and recommended by many teachers of botany would appear to have been especially designed to deter the intending student from the study of the science. Bristling at the outset with a formidable array of technical terms, which should never be introduced till a later stage of the instruction, they give a superficial countenance to the idea which is prevalent even with many who ought to know better, that Botany is a mere science of terms, unworthy to be placed by the side of Comparative Anatomy or Animal Physiology. Each teacher will no doubt have his own idea of the arrangement of his subject best calculated to interest the beginner, and to lead him on step by step to see the true dignity of the science. Dr. Masters's is recommended by his own experience as a lecturer for many years to one of our Metropolitan hospitals. He commences by taking in succession a series of flowers in the order in which they are tobe met with as the spring unfolds—willow, poplar, ash, elm, tulip, hyacinth, apple, lilac, and so forth; and in plain and attractive language, bringing in technical terms at the outset only when necessary for the sake of accuracy, he explains the structure of their different parts, and the points in which they resemble or differ from one another. The more important phenomena of the physiology of plants are also brought under review as the descriptions of structure naturally lead up to them, though we think that more space might with advantage have been bestowed on this portion of the subject. A single page devoted to the decomposition of carbonic acid by the leaves, and twelve lines to the process of fertilisation of the ovule, are hardly sufficient to introduce the reader to these branches of physiology, which are not only of the highest importance themselves, but also of far greater interest to the student, if simply and intelligently brought before him, than the details of morphology or of classification. The substance of this little book has already appeared in the columns of the *Gardener's Chronicle*, and it is well illustrated with capital wood-cuts. We heartily recommend "Botany for Beginners" to teachers or parents who are desirous of interesting young persons in this science, and who can appreciate the value of a clearly-written, simple, and yet accurate elementary treatise.

A. W. B.

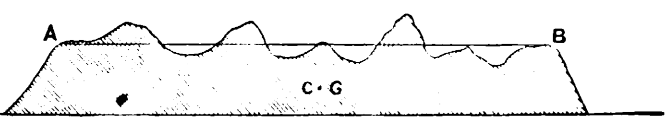
LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Error in Humboldt's Cosmos

THE following letter, from Major-General Sir Henry James, is addressed to Mr. J. Carrick Moore in reference to his communication which appeared in our columns under date April 18.

"I am much obliged to you for sending me NATURE, with your letter in it respecting the manner in which Humboldt has used the term 'Centre of Gravity of the Land,' by which he so far misled Herschel as to make him double the height of the mean elevation of the several continents. It is obvious that Humboldt determined the mean height of their surfaces, and not the height of the centres of gravity of the continents. He determined the height of A B, not of C G. The centres of gravity are, therefore, at half the heights given by Humboldt.



"I have the mean elevation of the surface of Forfarshire determined by the same method explained by you, and by which Humboldt determined the mean elevation of the surfaces of the continents; it was 856 feet above the mean level of the sea. The mean height of the surface of Europe (not of the centre of gravity) is, according to Humboldt, 671 feet, and this is quite as high as I should have expected it to be from the known height of Forfarshire, containing so large an amount of mountainous country. The mean height of the surface of Europe cannot be double this, or 1,042. The height of the water-shed between the Baltic, Black, and Caspian seas is only 1,100 feet.

"I think, therefore, both from the method of investigation and from the results, that you have taken a correct view of the subject, and that you have done science a great service in pointing out the error into which Humboldt has fallen, and by which he misled Herschel to so great an extent.

"John Carrick Moore, Esq." "HENRY JAMES

Southampton, April 22

Fertilisation of Dictamnus

AN arrangement for the distribution of the pollen of *Dictamnus Fraxinella*, which I noticed last June, may interest some of the botanical readers of NATURE. The plants will shortly be in flower, so that any one who is curious about the matter can see it for himself.

To suck the nectar of these flowers, bees stand upon the filaments, which are nearly horizontal; as the anthers are matured they are brought up in turn, generally two at a time, by the curving filaments, into such a position that they rub against the tail of a bee standing on the filaments. As soon as each pair of anthers is emptied they retire, and give place to another pair, and when the last are emptied the style curves up, and brings the stigma into the same position.

The difference in appearance between the empty and full anthers is very striking in dry weather.

Any one who knows the plants must have observed that they are very attractive to bees, and that they produce seeds in great abundance. CHRISTOPHER J. HAYDEN

Newspaper Science

THE general public cannot fail to acquire some very extraordinary as well as erroneous notions about many subjects relating to the progress and application of the different branches of Natural Science, if we are to judge from sundry scraps of information, daily communicated or reproduced for their instruction, in the columns of even the most influential newspapers. Amongst recent examples of this style style of information we might refer to the following:—

Geography.—Under the heading, "Oysters from South America," we find in the *Times* of May 16, the announcement that the steamer *Kaffraria* had last Sunday 'arrived at Hull from Norfolk, Virginia, having on board a cargo consisting of 500 or 600 tons of oysters, &c."

Geology.—The following is reproduced from the *Mechanics' Magazine* in the *Times* of May 16: —"*Per saltum.*—Nantwich in Cheshire has for some years past been gradually sinking, owing to the withdrawal of the lime from the salt lakes, which underlie the town," &c.

Chemistry.—In the *Times* of May 9 it is stated that "according to an analysis made by Prof. Zinno, the elements of the ashes that were thrown out from Mount Vesuvius are chlorine of soda, sulphate of lime, magnesia, allumen, iron, titanio, and silex."

Metallurgy.—The *Engineer* of April 12, in a paragraph on early iron making at Merthyr Tydvil, in South Wales, must rather astonish metallurgists by writing of "bones supplying sulphate of lime" in the process.

Architecture.—In a somewhat elaborate article on the new so-called Selenitic mortar, which in reality takes its name from the introduction of a little sulphate of lime, which when native forms the mineral called selenite in its manufacture, we are informed that "the name given to the improved mortar indicates to a certain extent the nature of the improvemeut; that it is in the direction of combining *selenious* acid with a base," &c. It would, indeed, be good tidings to chemists to find that selenious acid had become so cheap as to allow of its being used for such purposes; unfortunately, however, the last price lists inform us that selenium, from which it is made, still costs three shillings per drachm.

Although it has been said that it is not reasonable to expect scientific information from newspapers devoted to general topics, we still contend that we are entitled, when newspapers do make such statements, to demand that they shall at least be free from such gross blunders as those contained in the examples here cited, and to which many others might be added.

London, May 18 D. F.

The University of Freiberg

A LETTER signed "Undergraduate," in NATURE of May 9, confounds the School of Mines in Freiberg in Saxony with the University of Freiburg in Baden. The writer and others who wish to know where certain subjects are best taught in German universities will find much information in Ascherson's "Deutscher Universitäts-Kalender." This small book appears twice a year, giving the number of students and the names of lecturers and lectures offered each term in thirty-one universities of Germany, Switzerland, and the Baltic provinces of Russia.

Berlin, May 16 A. OPPENHEIM

Denudation of the Mendips

IN reply to the question of "Inquirer" in last week's number of NATURE, asking for explanation of a passage in my Address to the Geological Society, allow me to observe that geologists judge of the amount of denudation which hills formed by anticlinal axes, such as the Mendips and Ardennes, may have suffered, by prolonging across the range of hills the outcropping edges of the strata thrown up on the flanks of the axis, keeping each bed and each formation in its relative place. Thus, taking the thickness of the Somerset Coal measures, including the Millstone grit, to be on the north side of the Mendips about 9,000 feet, and of the Carboniferous limestone 1,500 feet; the whole of these, together with some upper part of the Old Red sandstone, forming together a mass of not less than 10,000 to 12,000 feet, have been removed from the area of the Mendips, the central axis of which is formed by strata of Old Red sandstone. In the case of the Ardennes, in addition to the Carboniferous strata, Devonian and Silurian strata are thrown up along the central axis at angles which prolonged form great arches, or rather a series of arches, over the hills; for here and there the intermediate synclinal curves bring in portions of the Coal Measures, which have thus been saved from denudation, while they show how much has been removed in the intermediate areas. The whole of the Coal measures, which are there rather thinner than in Somerset, the Lower Carboniferous series, which is much thicker than in England, together with the Devonian and part of the Silurian series, forming together a thickness probably of not less than 15,000 to 20,000 feet, are there removed from the central area.

It is, however, almost impossible to convey an exact notion of these great physical phenomena without illustrative sections and diagrams; and for these allow me to refer "Inquirer" to some papers in which such sections are given, and in which the subject, a very complicated one, is specially treated, viz., Professor Ramsay "On the Denudation of South Wales and the adjacent counties of England" (Memoirs of the Geological Survey of Great Britain, vol. i. p. 297); Dupont's "Essai d'une Carte Géologique des Environs de Dinant" (Bulletin de l'Académie Royale de Bruxelles, vol. xx. pp. 9 and 10); Réunion Extraordinaire de la Société Géologique de France à Liège (Bulletin de la Société Géologique, 2 ser., vol. xx. p. 761); Elie de Beaumont's and Dufrenoy's Explication de la Carte Géologique de la France, vol. i. pp. 240-64; also to Lyell's Elementary Manual of Geology, article, "Denudation;" and to De la Béché's 'Geological Observer,'" p. 815.

Shoreham, Kent, May 18 JOSEPH PRESTWICH

VOLCANOES AND EARTHQUAKES

THE remarkable series of volcanic phenomena which have lately been exhibited at various parts of the earth's surface within so short a period of time, gives much matter for consideration, and must in due time afford us a rich harvest of facts with which to test the numerous theories which have been started to account for the occurrence of volcanic eruptions and of earthquakes. Even from our at present scanty information we have, I think, something to learn.

First in the series, so far as I am aware, was the very severe earthquake at Independence, Inyo County, California, which took place on Tuesday, March 26, commencing at 2 A.M., and lasting till 7 A.M., during which time "the earth was never for a moment perfectly quiet, and every few minutes heavy shocks, of a few seconds' duration, were occurring; in all there were more than fifty very heavy shocks." This place is only fourteen miles from the Black Rock, a volcano in the Sierra Nevada mountains, "the sides of which are covered with lava, and which is supposed to be an extinct volcano." It is stated that "during the time the shocks were most severe, flashes of light were seen to issue from the top of this mountain, and streams of fire ran down its sides."

The result of this earthquake is summed up in a few words as "the whole country turned topsy-turvy" (*Virginia City* (Nevada) *Enterprise*).

Then a few days afterwards came the terrific earthquake in Antioch, which commenced on April 3, and continued with greater or less severity, "in Aleppo, and as far east as Orfa, beyond the Euphrates," for more than a week, becoming very severe on April 10; here there appears to have been no actual volcanic phenomenon; but it appears from the letters of the Rev. W. Brown in the *Times*, that there exists in the immediate neighbourhood a mountain, "the peculiar conical form of which is very suggestive of an ancient volcano."

The latest African news tells us that "Several violent shocks of earthquake had occurred at Accra, on the Gold Coast, on April 14 and 15, causing considerable damage to the place." And as unwonted atmospheric disturbances have often been connected with volcanic phenomena, it may not be out of place to mention here the fearful hurricane which wrecked every vessel but one in the Harbour of Zanzibar on April 15.

And then on April 24 began the recent eruption of Vesuvius, which will be for ever memorable, not only on account of its magnitude and grandeur, but also, and still most so, by reason of the amazing intrepidity of the man, who, from a pure love of science, remained at his post, like the gatekeeper of Pompeii, throughout the whole of that terrible time, but happily was not, like that heroic soldier, buried in a shower of ashes; the world was spared the loss.

Now is there any connection between these phenomena exhibited in so distant parts of the earth's surface? One thing is certain, namely, that within the short space of a month all this has occurred, and one can hardly help thinking that somehow or other these volcanic countries must be connected underground; it has long been thought that Etna and Vesuvius are points on a volcanic area which passes north-west to the Eifel, Auvergne, and Iceland; has the neighbourhood of Antioch, with its unenviable notoriety for earthquakes, or the West African coast, anything to do with this area? But if so, what shall we say of the Sierra Nevada, why should its volcanoes be active at the same time? Why should the country there be "turned topsy-turvy" by earthquakes?

While pointing out these coincidences, we must not jump too hastily to conclusions from them; for on the one hand we are told that although the Antioch earthquake extended so far east, yet, to the north and south, even at a few miles' distance, nothing whatever was observed, and, on the other hand, that the Californian earthquake was of so superficial a character that "at Hot Springs, while severe shocks were felt on the surface, the men in the mines, 200 feet deep, felt nothing of them." Now the evidence goes to show that the latter earthquake was directly connected with the eruption of a volcano in the neighbourhood, so that, although the origin of the disturbance may be underground, possibly at a very considerable depth, the shocks are at a certain distance quite superficial, and moreover are transmitted in certain definite directions.

Taking all these facts together, they would rather seem to favour the conclusions that at any rate a great many, if not all, of the volcanic regions of the world are connected, and that they are not merely parts of the earth's surface which happen to be over isolated subterranean furnaces, but places where access to the exterior is more easy for the molten matter which lies underneath a great part, perhaps all, of the earth's crust. I must not be understood to be upholding the (shall I say exploded?) theory of the internal fluidity of the earth; I merely mean to point out that such coincidences in point of time ought to make one hesitate before rushing to the other extreme, and looking upon volcanoes as mere local eccentricities.

But it will be said, if there is any general commotion under even the volcanic area of Europe, why do not the extinct volcanoes of Auvergne break out again? Here is a difficulty which is not at all solved by the suggestion that at first occurs to one, that as the raising of the country has drained the enormous lakes, on the borders of which these volcanoes stood, there is no longer a supply of water to rouse them into action, for are there not lakes still in the Eifel, nay, are not those lovely lakes actually in the craters of extinct volcanoes?

Again, who has seen the wonderful natural harbour of Messina from the high ground above the town without believing it to be an extinct submerged crater? If there be still liquid rock below these craters, it may be that they are no longer the points of least resistance. And this is the probable explanation of their inactivity; for it must not be imagined that an eruption of Etna or of Vesuvius, or of any other volcano, necessarily means an ejection of ashes, lava, &c., from the crater, or from any crater; not at all, the weakest point in the vicinity gives way, and thus we have the numerous cones formed which surround every considerable volcano for some distance.

The mention of Auvergne leads me to make a few remarks on the disputed point, as to whether or not the volcanoes in that country have been in eruption within historic times, especially as I see that a correspondent in last week's NATURE has come to the conclusion originally drawn by "an eminent historian and antiquary, Sir Francis Palgrave," as long ago as 1844, and adopted by theological writers ever since, that because a bishop of Vienne established Rogation days on account of some alarming terrestrial phenomena which happened in his diocese, therefore the volcanoes of Auvergne were in action at the time. We have two documents which refer to this matter, a letter written by Sidonius Apollinaris (who lived in the very centre of the Chaine des

Puys, and on the border of a lake which was actually formed by the damming up of a stream by one of the most recent of the lava-currents) to Mamertus, Bishop of Vienne, in which he speaks of the earthquakes that had occurred in the neighbourhood of Vienne; of fire issuing from the earth and wild beasts taking refuge in cities; and the Rogation Homily of Alcimus Avitus, the successor to Mamertus, which mentions the same catastrophes.

Now in the first place Vienne is more than seventy miles in a direct line from the more recent Auvergne volcanoes; in the next, Sidonius himself makes no mention in his writings of any eruptions having taken place in his neighbourhood, although he wrote poems describing the beauty of the scenery: and lastly Auvergne is not mentioned by any ancient writer, neither by Cæsar, who encamped there and laid siege to Gergovia, a city situated on a table-land, with craters close at hand in almost every direction; nor by Pliny, who gives a list of all the then known volcanic countries, including some very out-of-the-way ones; nor by Strabo, nor by any of the poets, as a country where volcanoes were ever known to have been in action.

For these reasons, and because no volcano could have burst out near Vienne without leaving some traces of its existence, Dr. Daubeny concluded that the bishops of Gaul alluded to earthquakes; especially as "the underground thunder, the opening of fissures in the ground, the bursting out of flames and gases, the projection of water and of stones, the smell of sulphur, the alarm evinced by the animals of the spot and neighbourhood, the elevation or depression of the land, noticed by Sidonius and by Avitus in the passages referred to by Sir Francis Palgrave, are all reported as concomitants of the great earthquakes which have occurred in more recent times." Geologists have since accepted this conclusion as the correct one, in opposition to what I may call the theological position.

There was, however, a volcanic region which had not been visited by any English geologist, and which had not been described, viz., the basin of Montbrison, through which the Loire flows. Of this Mr. Scrope says in his work (2nd Ed., p. 28), "a further examination of this basin seems very desirable;" now as this district lies about half way in a direct line between the "Puys," about Clermont Ferrand and Vienne, it occurred to Dr. Daubeny that the disturbances spoken of as in the neighbourhood of Vienne, might have taken place around Montbrison, and accordingly in the autumn of 1866 he visited that locality, and I had the honour of accompanying him on the occasion. We examined carefully the volcanic hills of the neighbourhood, and could find no trace of recent volcanic eruptions; in his own description of this expedition published in the *Quarterly Journal of Science* for January 1867, and republished in his "Miscellanies" (vol. i. p. 74), just before his death, he says:—

"I am now prepared to say that, without pretending to have surveyed the entire district, I saw enough to convince me that no volcanic disturbance which had occurred within this area at so late a period as that alluded to could have escaped our notice, and that every indication of igneous action which presents itself throughout the country, bears marks of a much greater antiquity.

"Thus much, at least, I can venture to affirm, namely, that neither, craters, streams of lava, scoriæ, nor even cellular trap, are to be met with anywhere within the limits of this district. On the contrary, the only igneous rocks which came under our observation consisted of a compact basalt, containing nests of olivine, a material which could only have been elaborated by the aid of great pressure, and under a different configuration of the surface from that now existing."

The Doctor therefore reiterated his statement that "the lively picture drawn by Sidonius" should not "be regarded in any other light than as the offspring of a lively imagination, dwelling upon reports which had reached the author with respect to some fearful earthquake which may have occurred in the neighbourhood of Vienne."*

I will conclude by advising those who wish to study volcanic phenomena to go to Auvergne, they can do so at almost any time of the year, mid-winter, when it is far too cold for comfort, being the exception; they will there see results of volcanic action far more varied and instructive than at Vesuvius or even at Etna, and they will also be able to study the effects of denudation on a gigantic scale. Few geologists seem to appreciate the fact that within 24 hours of London is one of the largest, richest, and most beautiful of the volcanic countries in Europe.

W. H. CORFIELD

PHOTOGRAPHY AS AN AID TO SCIENCE

THE applications made of photography now-a-days are as various as they are numerous. Irrespective of the ordinary every-day uses to which the art is put in reproducing scenes and objects, or pandering to human vanity, there are, as we know, numberless ways in which it is constantly being employed as a faithful handmaiden to science. To the chemist, the surgeon, the engineer, and others, its aid is frequently of considerable importance, while to the astronomer and physicist the assistance it renders is at times indispensable. The accuracy and fidelity with which the pencil of light performs its functions, combined with the facility with which such reliable records are obtained, make photography indeed one of the greatest boons at the disposal of scientific men.

Let us take, for example, the solar records which are daily secured at the Kew Observatory. These photographs of the sun's disc, taken whenever practicable at a certain fixed period in the day, are often of considerable value, and form illustrations, as it were, of other scientific observations made at the same time. A series of prints of this kind, secured day after day, afford, in truth, a most interesting and instructive lesson to the student of astronomy, for the characteristics exhibited by the various photographs may serve as a corroboration, or otherwise, of scientific theories based upon other data and results. The nature and luminosity of the markings, or spots, upon the disc are rendered with unerring fidelity, and the way in which these are continually modified in shape and intensity, as likewise the rapidity with which they are seen to travel across from the east to west limb of the sun, to reappear again some twelve days afterwards upon the eastern edge, is all clearly and distinctly shown.

Again, another interesting application of photography to astronomic purposes is to be found in the reproduction of the stars as recently undertaken by Prof. Rutherford. In this instance the objects to be secured are so minute that special precautions are necessary in depicting them upon the sensitive film, so that their impressions may be distinguishable from accidental specks in the collodion plate. To prevent any such chance of mistake, Prof. Rutherford secures a double image of each luminary, the moving telescope to which the miniature camera is attached being halted for a short time (half a minute) between a first and second exposure of the plate, so that each star is represented by a double speck, so to speak, upon the negative, and is clearly to be distinguished therefore, from any accidental defect in the film; moreover, by stopping the telescope again after the period necessary for the second exposure, the professor is enabled to demonstrate the direction in which the stars are moving, for the brightest of them produce a tiny streak of light during the time that the camera remains perfectly still. A map or plan of the heavens is in this

* Those who wish for further information will find the whole subject discussed in Dr. Daubeny's classical work on Volcanoes, and in his papers in the *Quarterly Journal of Science* for April 1866 and January 1867.

way secured, very slight and delicate in its nature, it is true, but yet one upon which implicit reliance can be placed when undertaking astronomical measurements. To those more particularly interested in operations of this kind, we may mention that a total exposure of six minutes sufficed for the depiction of these heavenly bodies in the camera.

Turning to another branch of the subject—micro-photography—we find the camera used for several purposes as important almost as those to which we have just referred. In the study of medicine, for instance, and the many sections of Natural History, photography lends a helping hand, so firm and true that we are at once guided to our destination. The large, clearly-defined diagrams of microscopic objects and medical preparations, which we are wont to see at many schools and colleges, cannot be prized too highly, forming as they do the best and most reliable proofs in support of facts and data, and being indeed of value alike to the professor as the student. And perhaps while treating on this particular subject, we may be allowed to refer also to the use made of the micro-camera during the siege of Paris for conveying news from and to that city. We have all heard how batches of private letters and whole sheets of newspapers have been reduced by means of photography to within the most insignificant limits, and produced upon a transparent pellicle, of which a pigeon might without inconvenience carry several under its tail, and how these precious films, on arrival at their destination, were forthwith placed in an enlarging apparatus or under a microscope, to be amplified to their original dimensions. Paris, it is said, contained upwards of a thousand pigeons qualified to act as messengers, and when it is asserted that on one occasion one of these birds arrived at Tours with several thousands of private messages and despatches, we ought by no means to be surprised that the communications between the French metropolis and the provinces were so numerous and frequent.

In the chemical, physical, and meteorological sciences, and even in that of war, photography aids in many ways, and thus helps to the advancement and progress of our knowledge of these matters. But the art, or art-science, as we may call it, has in several instances done something more than render yeoman's service to higher attainments; it has also been the means of discovering phenomena which could by no other means have been ascertained. In illustration of this may be mentioned the recent researches of Dr. Ozanam, undertaken for the purpose of defining the character of the pulsations of the heart; an investigation which has brought to light facts of considerable physiological importance. The instrument used by Dr. Ozanam was a thin India-rubber reservoir of mercury, having a glass tube attached, in which the quicksilver mounted to a certain height; the reservoir, on being placed in the vicinity of the patient's heart, was influenced by the beating of the latter, and the rise and fall of the mercury in the tube was thus made to indicate the ebb and flow of the blood, precisely in the same manner as a barometer registers the variations of the atmosphere. Behind the tube was arranged, by means of clockwork, a moveable strip of sensitive paper, or other suitable material, and this, as it ran along, was impressed by light, and received, in the form of an undulating line, a register of the fluctuations of the mercury column. The sensitive film passed along at the uniform rate of a centimetre per second, so that, presuming there to be one pulsation in that period of time, the wavy line representing a single beat would occupy the space of one centimetre. Of course, by enlarging the result to ten or twenty diameters, it was then, as may be supposed, easy to see what had taken place during the hundredth or thousandth part of a second, or beat, and the knowledge thus acquired, Dr. Ozanam believes, will be highly useful in preparing the diagnosis of a patient. One fact, of itself very important, has already been discovered by the aid of this ingenious instrument, viz., that not only as Dr. Maurey had before asserted, there exists dicrotism, or a double beat, in the normal pulse, but that the pulsation is even triple and quadruple in its action. The photographic line showed indeed that the column of mercury (representing of course, the blood in the arteries) bounded with one leap to the top of the scale and then descended again to its original level by three or four successive falls. Four descriptions of dicrotism have in this way been proved to exist, the fall of the pulse sometimes taking place in successive horizontal lines and sometimes in ascendant lines, the column reascending two or three times before falling altogether.

Another instance of scientific discovery by aid of photography is afforded in the observations of the spectrum by means of the camera. In Rutherford's picture of the solar spectrum obtained in this manner, there are many portions and lines shown (the ultra-violet for instance) which, while imperceptible to the retina of the eye, impress themselves very distinctly upon the sensitive film; and thus the presence of phenomena is proved of which but little was previously known. Of course the eye again descries certain lines, the yellow ones, which are without action upon the negative plate, and are not, therefore, recorded in the photograph, and thus it is only by carefully noting the results of both methods of observation that a true reproduction of the spectrum is obtainable. As a fact, we may mention, that single lines which are but faintly rendered in the Angström and Kirchhoff tables have been recorded by photography as well-marked double lines, while in some instances actually Rutherford shows indications by means of the camera of which there appears no vestige whatever in the records of other scientific men. In certain spectroscopic observations therefore, where special reliance is required to be placed upon the results, not only must an ocular observation be made, but the photographer's evidence must also be taken before any conclusions can be drawn from the aspect of the spectrum.

And before concluding we must not forget to refer to a still more recent instance in which photography has befriended the scientific investigator; we allude to the successful, although perhaps somewhat imperfect attempt which has been made by Prof. Young, to photograph the protuberances of the sun in ordinary daylight. A distinct reproduction of some of the double-headed prominences on the sun's limb has thus been obtained by the Professor; and although as a picture or mathematical record the impression may be of little value, still there is every reason to believe, now that the possibility of the operation is known, that with better and more suitable apparatus an exceedingly valuable and reliable record may be secured. Prof. Young employed for the purpose a spectroscope containing seven prisms, fitted to a telescope of 6½ inch apperture after the eyepiece of the same had been removed; the miniature camera, with the sensitive plate, was attached to the end of the spectroscope, the eyepiece of which acted in the capacity of a photographic lens, and projected the image on the collodion film. The exposure was necessarily a long one, amounting to three minutes and a half, and for this reason, as likewise on account of the unsteadiness of the air and the mal-adjustment of the polar axis of the equatorial, causing the image to shift its place slightly, the details of the image were somewhat blurred and destroyed. Moreover the eyepiece of the spectroscope was unsuitable for photographic purposes, and only in the centre yielded a true reproduction of the lines free from any distortion. A larger telescope will be required to secure a more defined image, and then, if more strict attention is paid to the clock-work arrangements and to the chemical manipulations, we may anticipate that a really valuable and important result will be obtained by this novel mode of observation.

H. BADEN PRITCHARD

AN EXPERIMENT TO ILLUSTRATE THE INDUCTION ON ITSELF OF AN ELECTRIC CURRENT

IT is well known that the sudden development of a current in a conductor is opposed by an influence analogous to the *inertia* of ordinary matter. A powerful movement of electricity cannot be suddenly produced; neither can it be suddenly stopped. One consequence is that a periodic interruption of a circuit in which a constant electromotive force acts is sufficient, when the self-induction is great, to stop all sensible current, even although the interruptions themselves may be of very short duration. Before any copious flow can be produced the circuit is broken, and the work has to be begun over again. Whether in any particular case the influence of self-induction is paramount, or not, will depend also on the *resistance* of the circuit, and on the rapidity of the intermittence. The magnitudes which really come into direct comparison are the interval between the breaks, and the time which would elapse while a current generated in the circuit, and then left to itself, falls to a specific fraction (such as one-half) of its original magnitude. In ordinary cases the duration of transient currents is but a small part of a second of time, so that, in order to bring out the effects of self-induction, the breaks must recur with considerable rapidity.

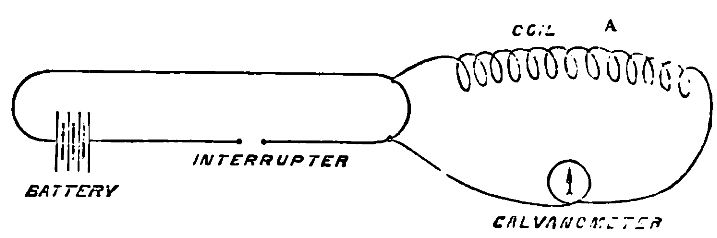
There is, however, one remarkable exception to the general rule, which occurs when, alongside of the principal coil to which the sluggishness is due, there exists an independent course along which the electricity can circulate. For instance, suppose that a coil with two wires, such as is often used for electro-magnets, is so arranged that one wire is included in the principal circuit, while the ends of the others are joined. The effect of the second circuit is then to neutralise the self-induction of the first, and so to increase largely the current that passes through it. Let us trace the progress of the phenomenon; supposing that the first circuit has been closed for a sufficient time to allow of the development of the full current which can be excited by the actual electromotive force.

The moment the rupture is complete, the current in the first wire must stop, but another of the same magnitude and direction is at once developed in the neighbouring circuit. In fact, in virtue of its *inertia*, the electrical motion tends to continue with as little change as possible, a result which is attained in great degree by the formation of the second current to fill the place of the first. In a short time the induced current would diminish and become insensible under the operation of resistance (analogous to ordinary friction); but we are supposing that before this takes place to any considerable extent the contact is renewed, and the electromotive force again begins, in the first circuit, to push the electricity on. It is now that the peculiarity of the arrangement manifests itself. The current instantly transfers itself back again to the first circuit, which thus, without any delay, has the advantage of the full current which the electromotive force can sustain. If it had not been for the second circuit and its current, the development in the first would only have been gradual, and by supposition so slow that it would be checked by another interruption before any considerable progress could be made. In short, the self-induction of the principal circuit is virtually destroyed.*

In my experiment the principal circuit consisted of a Smee cell and one wire of a coil belonging to a large electro-magnet, and which I may call A. The interrupter was a tuning-fork, arranged after Helmholtz, and set into regular vibrations of about 128 per second by an independent current and battery. The fork itself was forged by the village blacksmith, and the whole affair was home-made. Across one prong was placed a sort of rider of copper wire, dipping on either side into a mercury cup, and so arranged that during the vibration its ends should enter and leave the mercury, thereby establishing and interrupting the continuity of the circuit. The current was measured by means of a short wire galvanometer whose electrodes were connected with two neighbouring points of the circuit in such a manner that a small but constant proportion of the entire current passed through the instrument. The second wire of the coil, A_2, which is similar to the first and *put on with it*, formed the second circuit, when its ends were joined by a short wire. In order to increase at pleasure the effects of induction, iron wires or rods of about a quarter of an inch in diameter were provided, whose insertion in the coil materially increased the decisiveness of the result.

In the first place, the deflection produced on the galvanometer when the circuit was permanently completed was 58°, which fell to 39° when the interrupter was at work, the circuit of A_2 being open, and without iron. On closing A_2 the deflection rose to 46°. A_2 was again opened, and one iron wire introduced, which gave 30°. Two wires gave 25°, while the introduction of thirty reduced the deflection to 12°. Again closing A_2, the reading was 43°, raised to 44° only by the removal of the iron. It was clear that the second circuit almost secured the first from the influence of induction, which otherwise greatly reduced the electrical circulation. I may add that the arrangement was very efficient, the galvanometer needle remaining perfectly steady, so that the readings could be taken with ease and accuracy.

Another experiment made at the same time (about two years ago) may be noticed, if only for its contrast with the preceding. The coil A, being removed from the main circuit, was included in the branch with the galvanometer, as shown in the figure. Here neither the insertion of



iron nor the closing of A_2 made any difference; the circuit containing the coil remaining always closed, whatever might be the condition of the other. In such circumstances the average current indicated by the galvanometer is independent of the self-induction of the coil, varying only with the resistance in the branch, and with the *average* difference of potential at the points of derivation.

J. W. STRUTT

* Mathematicians familiar with the theory of electricity will follow this by putting the three induction co-efficients (in Maxwell's notation, L, M, N) equal, and the resistance of the second circuit, S, equal to zero.

SOME REMARKS ON THE HABITS OF SOME CEYLON ANIMALS, AND NOTES ON METHODS FOR KEEPING THEM ALIVE IN CONFINEMENT

AFTER my duties as member of the Eclipse Expedition were over, I spent some time in Ceylon collecting natural history specimens for the Oxford Museum. Besides preserving a large series of animals in solutions, I obtained through the kindness of my friend, Mr. G. H. K. Thwaites, F.R.S., of Peradeniya, whose kind hospitality I enjoyed, and to whom I am indebted for nearly all my best specimens and information concerning them, various living examples of the Ceylon fauna, and I kept them with more or less success in confinement. Some notes as to my experiences with regard to them may be of interest to the readers of NATURE.

Passerita mycterizans.—A brilliant emerald green tree snake, with horizontal pupil. I obtained a fine specimen about 4½ ft. long. I put him in a small wooden box with wire-gauze cover. As usual with this species, he would not feed, but drank frequently with great eagerness. Snakes often die in confinement for want of water. In the case of tropical snakes, it should not be forgotten that the water must be warmed as soon as colder latitudes are reached. This snake is now in the Regent's Park Zoological Gardens, and has now been two months without food. The keeper tells me that a specimen formerly in the Gardens lived six months without eating.*

Lyriocephalus scutatus.—These lizards live in large numbers in the Royal Botanic Gardens, Peradeniya, frequenting the moist shady banks of the Mahawillaganga, which bounds the Gardens in one direction. The animals sit all day on tree trunks, with their head uppermost. They can run very fast, but are easily caught, as is the case with most lizards, with a slip noose of palm fibre. They allow the noose to be put over their heads with the greatest ease. When first caught they are very fierce, and display their array of sharp teeth and bright scarlet mouths whenever a finger is moved near them, and they bite hard whenever they get a chance, holding like bull-dogs, as I often experienced to my cost when feeding them. I could not get them to feed themselves either whilst in Ceylon or on the voyage home. I therefore fed them by hand, opening their mouths forcibly by pulling on the pouch-skin and pushing worms down their throats. After a time they chewed and swallowed the worms readily on their being put in their mouths. I also poured water down their throats. I kept a stock of worms alive at the bottom of the cage in moist earth. Kelaart, in his Nat. Hist. of Ceylon, says that Lyriocephalus takes boiled rice freely in confinement; and Dr. Günther, "Indian Reports," p. 129, quotes him to that effect. I think this must be an entirely erroneous statement. I forced rice down the animals' throats, but they never seemed to relish it, and they never touched it of themselves whilst under my care, nor have they done so since they have been in the Regent's Park Gardens. The lizards are remarkable for their curious lyre-shaped heads, and the large knobs on the ends of the snouts of the adults. In young specimens the knob is very little developed. It is present in both sexes. The lizards change colour with great rapidity when excited, even whilst held in the hand. They were brought home in a tall wooden cage, by the advice of Mr. Thwaites so arranged that they could rest in their usual vertical position on some rough bark nailed on to the sides of the cage for the purpose. They clung on to these supports and the perforated zinc front during all the voyage home, and in their den in the reptile house in the Gardens they are always to be seen clinging to the branches head uppermost. The cage was kept on the voyage from Alexandria to Southampton in the engine-room of the P. and O. steamship *Mooltan*, as was also the box with the tree snake, and both were taken up to town from thence wrapped in a double blanket. Four of the lizards are now alive in the Regent's Park Gardens. They are still fed by hand, but one has been seen by the keeper to help himself to worms. Some time ago an attempt was made by Mr. Houldsworth to bring Lyriocephali home alive, but his specimens unluckily died in the Channel. Perhaps they were not hand-fed.

The ground in Ceylon swarms with burrowing reptiles of various kinds, and Mr. Thwaites's coolies used to dig me up as many as twenty in an afternoon. They all came from the moist river bank. Most abundant in the various lots I received was always *Nessia monodactyla*, a lizard which, having taken to underground habits, has become snake-like, and retains the merest rudiments of both its limbs. I kept all my underground reptiles in damp moss in joints of the gigantic bamboo. The *Nessias* move with great agility through the moss, and lived well in confinement. I hardly ever saw one in which the tail was not a reproduction.

Rhinophis Bythii.—These were not half so nimble as the *Nessias*, and seemed rather more delicate.

Typhlops braminus. — These small blind-worm-like snakes were not so abundant as the *Rhinophidæ* or *Nessias*, but there were generally one or two in each batch. They are very active, escape through the smallest crack, and are with difficulty retained in the hand. I kept the *Nessias*, *Rhinophidæ*, and *Typhlopidæ* together in a bamboo. I gave them earth-worms. The worms disappeared, but also did the *Typhlopidæ*. These could not have escaped; but were probably eaten by the *Rhinophidæ*.

Cæcilians.—Epicrium glutinosum.—I had only four specimens brought me of *Cæcilia*. They came from the same bank as the *Nessias*, &c. They move along the ground with a slow helpless wriggling motion, feeling their way with their remarkable exsertile labial tentacles. These tentacles are in constant motion, being alternately protruded and retracted. They are evidently the animals great stand-by in the special-sense way, and probably contain interesting terminal nervous organs. The Cæcilians have a certain amount of prehensile power in their tails. When placed in water they are very active, moving like eels, and seeming to enjoy themselves thoroughly. I kept them in moss in a bamboo, and put worms with them, which disappeared in no small quantities.

Mygale marmorata.—This spider, a full-sized one, ate clean up five large cockroaches in the first two nights I had it. A day later it cast up a large pellet, composed of the chitinous skins of its victims, just as a rapacious bird casts up feather pellets. It spun a small quantity of irregular web against the side of its cage. As far as I could observe, the spider did not feed again in the three weeks during which I kept it alive.

Scorpion hubrostonos.—These large black scorpions I could not get to feed at all, though I tried them with insects and raw meat.

Land Planarians.—Bipalium Diana, B. Proserpina, B. Phœbe, and *Rhynchodemus Nietneri.*—I obtained numbers of specimens of these huge Planarians, some as much as eight inches long. I tried several times to keep them alive amongst moist leaves, but unfortunately failed. They never lived longer than four or five days, then appeared to deliquesce into a slimy mass of corruption.* The slime of these Planarians is so tough that they can suspend themselves by a thread formed of it, and I have several times had them lower themselves thus from my hand to a table by means of a thread six or seven inches long. I have only seen *Bipalium Diana* and *Proserpina* do this, not *Rhynchodemus*. The cellar slug, *Limax agrestis*, uses a mucous thread for suspension in a similar manner (Binney's "Terrestrial and Air-breathing Molluscs of the United States," vol. ii. p. 39). When in motion, the Bipaliums throw out a series of short tentacular-like papillæ from the front edge of their semicircular anterior extremity. I had all the animals I have mentioned, except the Planarians, alive as far as Suez, but unfortunately they were all killed by the intense cold of the night journey across the desert to Alexandria, except the Lyriocephali and Passeritia, which I took in the carriage with me and kept warm. The train was so crowded that I was obliged to put the rest in the van. I especially grieved over the loss of the Cæcilians; they were especially well and healthy, and I feel certain I should have got them home alive had it not been for this mishap. I had hoped to be able to get them to breed, and to watch their development.

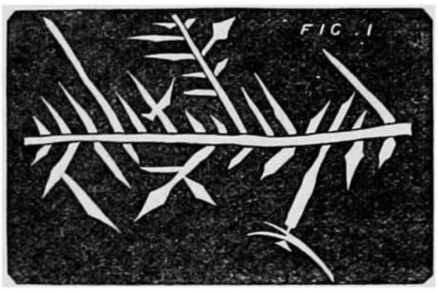
H. N. MOSELEY

* Since the above was written this snake has not only swallowed a young bird, but has also attempted to swallow another snake of a different species confined in the same cage.

* Mr. Darwin had much better success with the South American Land Planarians.—"Darwin's Journal of Researches," 1860 Edition, p. 27.

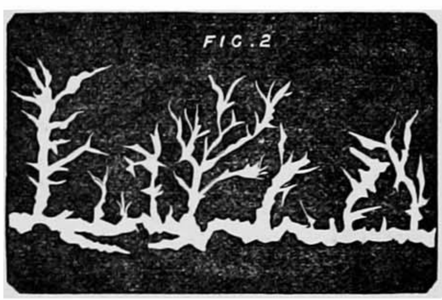
ON THE CRYSTALLISATION OF SILVER, GOLD, AND OTHER METALS *

THERE are few chemical experiments so well known as the growth of the "lead tree" a specimen of which is on the table, together with a "silver tree" that is said to have been made by the late Professor Faraday. These carry our minds back to the time of the alchemists, who called the first "arbor Saturni," and the second "arbor Dianæ;" and they may be looked upon as the types of a large number of phenomena, in which the salt of one metal in solution is decomposed by some other metal. My assistant, Mr. Tribe, and myself have been lately ex-



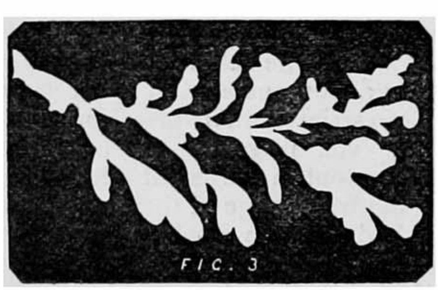
amining these replacements, the metallic crystals which are thus produced, and the forces that act through the liquid.

Our more special attention has been given to the mutual action of copper and nitrate of silver. If these two substances be brought into contact by the intervention of water, there grow upon the red metal what may be well



called "trees," and though the analogy between crystals and plants is a very superficial one, yet the resemblances of external form are striking enough, and a nomenclature drawn from the garden seems the most expressive.

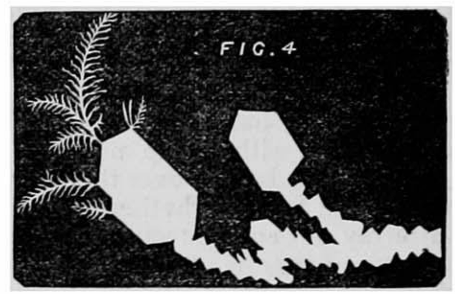
It is very beautiful to watch the growth of these silver crystals round a piece of copper under the microscope; a blue glass underneath adds to the effect, and they are



best seen when they reflect a strong light thrown upon them. They may also be thrown upon a screen as opaque objects, but the beauty and lustre of their surface is in this way lost.

The crystals of silver thus produced differ both in colour and form, according to the strength of the solution. If it be very weak, say one per cent, the copper is fringed with black bushes of the metal, which, in growing, change their colour to white without any alteration of crystalline form that can be detected by a powerful microscope. A stronger solution gives white crystals from the commencement, which frequently assume the appearance of fern-leaves; while the growth from a still stronger liquid reminds us rather of a furze bush. If the nitrate of silver amount to 15 per cent., or thereabouts, there occurs a steady advance of brilliantly white moss; and if the solution be saturated, or nearly so, say 40 per cent., this moss is very sturdy, often ending in solid crystalline knobs, or strretching out into the liquid as an arborescent fringe.

In all these cases, however, when the solution in front of the growing crystals has been somewhat exhausted, certain prominent or well-circumstanced crystals seem to



monopolise the power, and to push forward through the remaining portions of the liquid. This gives rise to beautiful branches which assume a variety of graceful forms, which it is hopeless to attempt to pourtray by diagrams, but of which the subjoined figures give some of the more characteristic outlines greatly magnified. The weak solutions produce feathery crystals somewhat as in

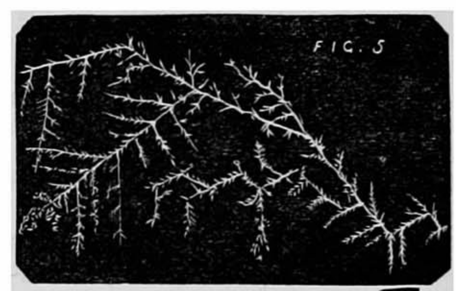
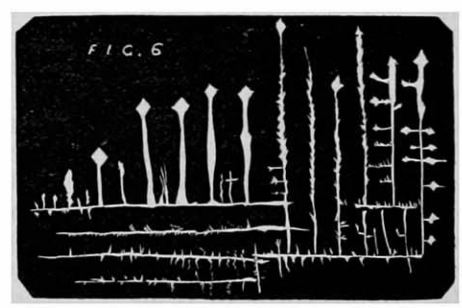


Fig. 1, consisting of a straight central stem from which grow on either side crystalline rays that terminate in a sharp point, and frequently become themselves the centre stems of a similar crystalline structure. In the outlying growth of a moderately strong solution the apparent regularity of the crystalline form is lost; the main stem is built up of a confused mass of hexagonal plates, while



the side branches are an agglomeration of minute pointed crystals turning in every direction, and producing such jagged outlines as are drawn in Fig. 2. In stronger solutions still the branches lose every appearance of straightness, and they are built up of hexagonal plates so studded with crystalline specks that the whole has the rounded appearance depicted in Fig. 3. The arborescent crystals that succeed the fringes from a saturated solution, are smaller in their foliage than the last, and end in little spherical or botryoidal knobs.

* Lecture delivered at the Royal Institution of Great Britain, February 16, 1872, by John Hall Gladstone, F.R.S.

Beside these various forms, there occur all kinds of crystalline combinations, as, for instance, the spray sketched in Fig. 4, where the rough branches have terminated each in a large hexagonal plate, and the flowing past of a weakened solution has afterwards caused the growth of delicate fern-leaves. Often, too, a large expansion will take place in every direction, though joined to the parent stem by an almost invisible thread ; or from the point of a long crystal there will branch out to right and left crescent-shaped structures, a process the commencement of which is seen in one of the side rays of Fig. 1. The last traces of silver in the liquid will frequently give rise to delicate crystalline filaments wandering over the surface of the glass, as in Fig. 5.

If a piece of zinc be placed in a solution of neutral terchloride of gold, containing 9 per cent. of salt, there is an immediate outgrowth of black gold, which speedily changes to an advancing mass of yellow or perhaps lilac metal in lichen-like forms, from which proceed beautiful fringes of yellow or black, ending generally in such arborescent forms as are represented in Fig. 7. As these branches push into the yellow liquid, it becomes colourless even in advance of their points, and it frequently happens that yellow crystals of some salt shoot out in front of the crystallising metal, which follows them and builds up its advancing fronds at their expense. This is shown in the figure. The gold will generally shoot its yellow branches rapidly round the margin of the drop. Such a running branch has been seen to stop on touching at one point a loose piece of gold, which immediately in its turn became active, and commenced to sprout on its farther side. Copper salts give round nodules, which have no crystalline appearance when deposited from moderately weak solutions, but a very strong solution of the chloride—about 40 per cent.—yields with zinc first a black thick growth, then arborescent fringes of red metal, terminating in crystals of very appreciable size.

FIG 7

The fringes referred to in the case of these three metals are still more characteristically developed by bismuth. When a solution of terchloride of bismuth acts on zinc, there is an immediate outgrowth of black fringes, such as Fig. 8, where they are seen on an illuminated field. These, as they advance, become more and more arborescent, and as the crystalline character develops itself more they change from black to grey. Sometimes bismuth presents itself in botryoidal masses, but the tendency to form these fringes is very strong.

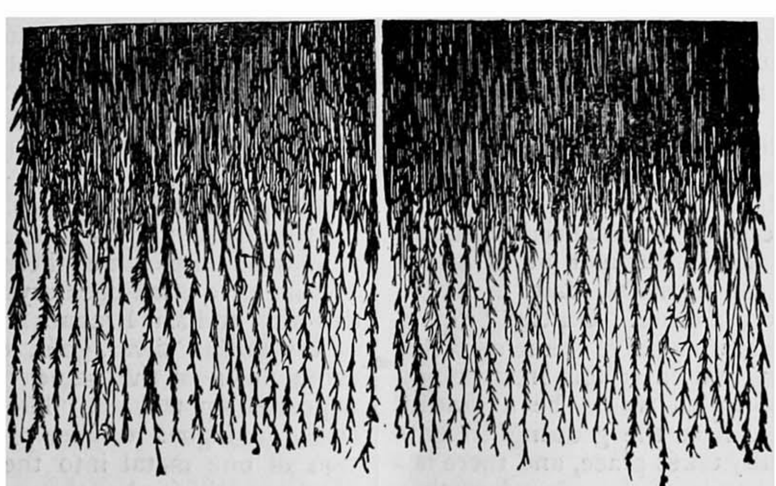


FIG. 8

Chloride of antimony with zinc also gives these black fringes. Lead salts yield crystals resembling those of silver; but leaves of irregular hexagonal plates prevail, and often grow to a large size. A solution of acetate of thallium, containing 20 per cent. of salt, quickly gives a beautiful forest of thorny crystals. Sulphate of cadmium gives rise to a small leaf-like growth on zinc ; but a strong solution of chloride produces an appearance of sticks covered with small spines or knobs. The new metal indium is thrown down upon zinc in the form of thick white crystals. The deposition is promoted by touching the zinc with a piece of iron.

Tin gives beautiful results. If zinc be placed in a solution of stannous chloride, it is quickly surrounded with an outgrowth of prolonged octohedra, and as these advance into the liquid it is easy to observe that the additions of new metal commence at the apex, and that the wave of chemical change proceeds down the lateral edge, occupying some seconds of time in depositing the new layer of material. Frequently, also, there is a luxuriant growth of large flat leaflets, or of symmetrical structures resembling fern-leaves, but with the fronds arranged at right angles, or combinations of these with octohedra, as shown in Fig. 6. These fern-leaves often begin of a dull grey colour; but, as they advance, suddenly change to a brilliant white.

The particular form of these crystalline growths depends, therefore, primarily, on the specific character of the metal; but this is greatly modified by the strength of the solution.

The forms assumed by native metals resemble those produced by this process of substitution. In some cases, indeed, it seems almost certain that the deposition of these minerals was effected in the same way, as, for instance, the silver which occurs sometimes in tufts, sometimes in large crystals, on the native copper of the Lake Superior district. Gold is frequently found in cubes more or less rolled, but the leaf gold from Transylvania bears a striking likeness to the crystals that form in our laboratory experiments. Silver is often found native as twisted hairs or wires of metal—a form that never occurs in the decomposition of its nitrate by copper, but which can be artificially produced in another way.

There has been noticed a singular tendency in old silver ornaments and coins to become crystalline and friable. Here is an ancient fibula from the island of Cyprus, supposed to be at least 1,500 years old, which, through the greater portion of its substance, presents a fracture something like that of cast-iron, and its specific gravity has been reduced in round numbers from 10 to 9. It contains a little copper. This property of certain metals or their alloys to change in condition and volume, is worthy the attention of those whose duty it is to make our standards. Experiments should be instituted for the purpose of learning what metals or combinations of metals are least subject to this secular change.

These metallic crystals are Nature's first attempt at building. This material is the simplest possible—in fact, what chemists look upon as elementary. But how is the building carried on? What are the tools employed? Where are the bearers of burdens that bring the prepared pieces and lay them together according to the plan of the Great Architect? We must try to imagine what is taking place in the transparent solution. The silver, of course, existed at first in combination with the nitric element, and for every particle of silver deposited on the growing tree, an equivalent particle of copper is dissolved from the surface of the plate. The nitric element never ceases to be in combination with a metal, but is transferred from the one metal to the other. On the "Polarisation Theory," the positive and negative elements of the salt constantly change places and enter into fresh combinations, one consequence of which would be a gradual passage of the nitric element from the growing silver to the copper plate. This actually takes place, and there is a diminution of the salt at the ends of the silver branches, giving rise to an upward current, and a condensation of nitrate of copper against the copper plate, which gives rise to a strong downward current. These two currents are seen in every reaction of this nature. In the case of silver and copper, however, it has been proved that the crowding of the salt towards the copper plate is more rapid than would follow from the usual polarisation theory. The instrument employed for determining this point was a divided cell in which two plates, one of silver and the other of copper, connected together by a wire, are immersed each in a solution of its own nitrate, contained in each division of the cell, and separated from one another merely by parchment paper. The crystals of silver deposited on the silver plate in this experiment are very brilliant.

There are other indications of the liquid being put into a special condition by the presence of the two metals which touch one another. Thus zinc alone is incapable of decomposing pure water; but if copper or platinum be deposited on the zinc in such a manner that the water can have free access to the junction of the two metals, a decomposition is effected; oxide of zinc is formed, and hydrogen gas is evolved. At the ordinary temperature the bubbles of gas rise slowly through the liquid, but if the whole be placed in a flask and heated pure hydrogen is given off in large quantity. We have also found that iron or lead similarly brought into intimate union with a more electro-negative metal, and well washed, will decompose pure water.

As might be expected, the action of magnesium on water may be greatly enhanced by this method; and a pretty and instructive experiment may be made by placing a coil of magnesium in pure water at the ordinary temperature, when there will be scarcely any effect visible, and then adding a solution of sulphate of copper. The magnesium is instantly covered with a growth of the other metal, and at the same time the liquid seems to boil with the rapid evolution of hydrogen bubbles from the decomposed water.

When, however, the force of the two metals in contact has to traverse a layer of water, the resistance offered by the fluid prevents its decomposition. This must also be an important element in the decomposition of a metallic salt dissolved in water, and in fact we have found that the addition of some neutral salt, such as nitrate of potassium, increases the action—apparently by diminishing the resistance of the liquid. If, too, we increase the quantity of the dissolved metallic salt, we get more than a proportional increase of deposited metal. Thus, in an experiment made with the different strengths of nitrate of silver on the table, the following results were obtained in ten minutes, all the circumstances being the same except the strength of the solution:—

1	per cent. solution	dissolved	·025	grm. copper.
2	„	„	„	·078	„
4	„	„	„	·224	„

In fact it has been found that in solutions not exceeding 5 per cent., twice the amount of nitrate of silver dissolved in water gives three times the amount of chemical action; and this is true with other metals also in weak solution. It may be that this is not the precise expression of a physical law, but it agrees at least very closely with the results of experiment.

The power arising from this action of two metals on a binary liquid may be carried to a distance and produce similar decompositions there. This is ordinary electrolysis. Metals have often been crystallised from their solutions in this way, and Mr. Braham has made excellent preparations of crystalline silver, gold, copper, tin, platinum, &c., by using poles of the same metal as that intended to be deposited upon them. The forms thus obtained are precisely analogous to those produced by the simple immersion of one metal into the soluble salt of another, and illustrate still further the essential unity of the force that originates the two classes of phenomena.

NOTES

THE speech of the Prime Minister at the meeting held last week in support of the fund to pay off the debt at King's College was a striking comment on some recent utterances of members of the Government to the effect that Science is well able to support itself, and needs no assistance from the State. The claims of this fund on public assistance were earnestly and eloquently urged on the ground that King's College was an institution founded to promote the union between Science and Religion, and therefore the happiness of mankind. In the course of the meeting it was mentioned that the works connected with the Thames Embankment have entirely destroyed the dining-hall of the College, entailing a loss of 1,400*l*. or 1,500*l*., for which no legal redress can be obtained; and this although noble dukes receive compensation to the extent of thousands of pounds for the injury inflicted on the privacy of their gardens by the same works.

ON the occasion of the annual conferring of degrees by the University of London on the 15th inst., Mr. Lowe, who is a member of the Senate of the University and its representative in Parliament, expressed an opinion in favour of making Greek an optional subject at the Matriculation Examination, to be substituted either by an additional modern language, or by some branch of natural or physical science. The proposed change has now been before the body of graduates for the last two years, but has not yet received the sanction of Convocation. At the last meeting, on the 14th inst., the subject was referred back to the Annual Committee of Convocation for further consideration. In the course of the same speech, Mr. Lowe urged benefactors of education to leave money for the endowment of scholarships at the University, rather than of professorial chairs, on the ground that the pay of lecturers ought to be in proportion to the amount of instruction they give, *i.e.* to the number of their pupils. Mr. Lowe appears, however, to forget that quality, as well as quantity, is required in teaching, and that this quality can only be secured by original work, to devote himself to which the professor must be to a certain extent independent of the emoluments derived from actual teaching.

THE special correspondent of the *Daily News*, writing from Zanzibar under date of April 19, states that no letters had been received there from either Dr. Livingstone or Mr. Stanley up to that date, and that war was still going on in Unyanyembe between the Arabs and the natives. The terrible hurricane of the 13th had wrecked every vessel in the harbour of Zanzibar except the *Abydos*; the harbour was then one mass of wreck, and European residents expect that a famine may be the result, the cocoa-nut and clove-trees, the chief products of the island, having been almost entirely destroyed, and that trade will be brought to a standstill for some time. Mr. Horace Waller forwards to the *Times* a letter just received from Mr. Oswell Livingstone, in which he speaks of the expedition being detained in Zanzibar by the hurricane up to April 20; and Prof. Corfield sends one to the same journal from Dr. James Christie, physician to the Sultan of Zanzibar, who says that he believes Dr. Livingstone is alive and well, and that Mr. Stanley has relieved him at Ujiji, and that he would not be surprised to meet them both in Zanzibar any day.

WE are very glad to be able to announce that the United States Senate has unanimously passed a bill, appropriating 50,000 dols. to meet the expenses of the observations upon the transit of Venus in 1874, on the part of the National Observatory in Washington. The bill has been introduced into the Lower House, and will doubtless soon become a law.

PROF. PALMIERI of Naples has received an address, signed by seventy citizens of Rome, expressing their admiration of his character and conduct, and congratulating him on the success of his efforts to save numerous victims from destruction in the late terrible eruption of Vesuvius. A communication from Rome states that he is to be nominated a senator of the Kingdom of Italy.

THE Royal Danish Society of Copenhagen offers the following prizes for competition during the ensuing year:—For a description of the spectra of the planets Venus, Mars, Jupiter, Saturn, and Uranus, which shall determine the question relating to the position and special nature of the principal lines, accompanied by a critical comparison of the results previously obtained by Huggins, Secchi, Vogel, and, as respects Jupiter, by Le Sueur, of Melbourne—the gold medal of the Society, together with a sum of money of fifty Danish ducats (450 frs.). For a thorough research into the organic reproduction of one of the groups of setiferous Annelidæ, the Naididæ, Scyllidæ, or Serpulidæ, especially with relation to the question whether the same individuals are both gemmiferous and sexual, or whether the sexual and organic modes of reproduction are strictly separated in different individuals and generations, accompanied by the necessary drawings—the gold medal of the Society. The essays may be written in Latin, French, English, German, Swedish, or Danish; and must be addressed before the end of October 1873 to the secretary of the society, M. J. J. S. Steenstrup.

SOME little time ago we noticed in our columns an effort that was being made to raise a memorial to the late Sir R. Rede, the founder of the Rede Lecture at Cambridge, and we are glad to be able to state that in consequence several fresh subscribers have added their names to the list, so that the fund now amounts to 80*l*., which is exactly one half of the sum required for the window that it is proposed to fill with stained glass in the church where the remains of this far-seeing friend to knowledge rest. The Rede Lecture is to be delivered in the Senate House, Cambridge, on Friday, 24th inst., by Mr. Edward H. Freeman, D.C.L., on the Unity of History, and it is hoped that members of the University, as well as others interested in the promotion of science, will contribute towards the completion of the memorial of which a partial commencement has been made by inserting a portion of the glass. The Rev. Professor Selwyn, D.D., has kindly consented to receive subscriptions at Mortlock's Bank, Cambridge, "Rede Memorial Fund;" and Mr. Norman Lockyer, F.R.S., the late Rede lecturer, in London, at 6, Old Palace Yard, Westminster. The names of the subscribers will be found in our advertising columns.

WE have to record with great satisfaction the appointment of Mr. M. J. Barrington Ward, B.A., F.L.S., to be one of Her Majesty's Inspectors of Schools. Mr. Barrington Ward was a scholar of Magdalene Hall, and first of his year in Natural Science at Oxford. He has recently occupied the post of Science-master at Clifton College.

THE post of teacher of Chemistry at Clifton College will be vacant at the end of the present term.

AMONG recent deaths of persons eminent in Science, *Harper's Weekly* mentions that of Dr. Samuel Jackson, former Professor of the Institutes of Medicine of the University of Pennsylvania, which took place at Philadelphia on the 5th of April last. Dr. Jackson was born in Philadelphia in 1787, and was therefore eighty-five years of age. He held the position of active professor for twenty-eight years, and retired in 1863. He was well known as a physician and surgeon of great eminence, and for a long time occupied a leading position. He was also an author of some celebrity, and popular as a lecturer. His most important work was "The Principles of Medicine," first published in 1832, and which has gone through numerous editions.

A COMMUNICATION was presented to the National Academy of Sciences at Washington, at its annual meeting, on April 16 last, from Prof. Agassiz, dated Monte Video, February 26. In this he expresses his gratification at finding evident traces of glacial action in the vicinity of Monte Video, as shown by the occurrence of phenomena which were quite satisfactory to his mind. He leaves the question undecided as to the origin of the erratic boulders found scattered over the surface, but hopes that his further investigation in the southern hemisphere will enable him to supply the necessary data.

PROF. CORFIELD will commence a course of twelve lectures on Hygiene and Public Health at University College, London, on Tuesday next, at 12 o'clock.

AT the last exhibition of the Royal Horticultural Society an interesting feature was introduced in the shape of prizes offered for the best dinner-table decorations. The competing tables were laid out in two tents in the gardens, and were an object of great attraction. Many of them were remarkable for the taste displayed in the arrragements.

A FUND was started some time ago to promote the investigation of the Wealden formation of Sussex, especially with reference to the question of the supposed underlying coal strata. Large subscriptions have already been received for this purpose; the Duke of Devonshire has promised 250*l.*, and Lord Leconfield 100*l.* It is believed by many geologists that coal in large quantities may occur in strata beneath some of the longitudinal folds of the Wealden denudation, and form a continuation of the Belgian coal beds.

THE Ethnological Collection of the Oxford Museum has lately been enriched by the presentation to it of some North Australian spears, by Captain Halpin, of the *Great Eastern.* Captain Halpin, in his capacity as chief of the Expedition which laid the cable to Australia last year, visited Port Darwin, and there obtained these weapons. One of the spears has a stone head. The stone of which it is formed is a sort of shale. The head is large, very sharp, and of the unground type. The Oxford Ethnological series is, under the hands of Prof. Rolleston, becoming a very valuable and complete one indeed, and those who are in possession of authentic crania or weapons of interest from an ethnological view, cannot do better than contribute to it. Canon Greenwell has lately presented the whole of his valuable collection.

THE *American Naturalist* is responsible for the following story, which we could hardly have credited except on such authority:—"Central Park Museum.—Destruction of Mr. Hawkins' Restorations.—A *Times* reporter called yesterday on Mr. B. Waterhouse Hawkins in order to ascertain the truth of the allegations made in a communication which appeared in yesterday's *Times* in reference to the destruction of his restorations in the Central Park Museum. Mr. Hawkins stated that all he had done during twenty-one months to restore the skeletons of the extinct animals of America (of the *Hadrosaurus*, and the other gigantic animal, which was thirty-nine feet long), was destroyed by order of Mr. Henry Hilton, on the 3rd of May last, with sledge-hammer, and carted away to Mount St. Vincent, where the remains were buried several feet below the surface. The preparatory sketches of other animals, including a mammoth and a mastodon, and the moulds and sketch models, were destroyed. Mr. Hilton did this, said Mr. Hawkins, out of ignorance, just as he had a coat of white paint put on the skeleton of a whale which Mr. Peter Cooper had presented to the Museum, and just as he had a bronze statue painted white. Mr. Hilton told the celebrated naturalist who had come from England to undertake the work, that he should not bother himself with 'dead animals,' that there was plenty to do among the living. When the skeletons were dug up again, by order of Col. Stebbins, they were found broken in thousands of pieces. Prof. Henry, of the Smithsonian Institution, when he heard of this piece of barbarism, would not believe it. 'Why,' he exclaimed, 'I would have paid them a good price for it.' Mr. Hilton, however, preferred to destroy the work of the naturalist which had cost the City at least twelve thousand dollars." The proceeding appears to have met with universal reprobation from the Americans. The *Naturalist* refers by way of contrast to the record in our columns of the preservation of the great megalithic monument at Avebury, through the public spirit of Sir John Lubbock.

THE poorest flora in the world is probably that of the island of St. Paul in the Indian Ocean, an account of which appears in the "Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien" for 1871. It consists, as far as flowering plants are concerned, of six grasses, a sedge, a *Plantago*, and a *Sagina*. Of these the two latter only are undescribed species, and all the remainder have probably been introduced.

THE Acclimatisation Society of Auckland, New Zealand, has printed its fifth Annual Report. The efforts of the Society during the preceding year have been chiefly devoted to the introduction of insectivorous birds from England and Australia, and of freshwater fish. In both these respects the Society has met with greater success than in previous years, and appears to be performing work of great service to the colony. The gardens of the Society have also been considerably enlarged.

SEVEN parts are now published of the new edition of Griffith and Henfrey's Micrographic Dictionary, edited by Dr. Griffith, the Rev. M. J. Berkeley, and Prof. T. Rupert Jones, of which we have already noticed the issue of the first number. They bring down the articles as far as *Confervoideæ*.

DR. CHARLES C. ABBOTT has reprinted his elaborate and profusely-illustrated article on the "Stone Age of New Jersey," which has been running through several numbers of the *American Naturalist.*

THE Danish war steamer *Fylla* has been ordered by the Danish Government to take soundings and survey landing-places for the submarine telegraph line intended to connect Scotland with Canada *viâ* the Faroe Islands. It is to be hoped that these soundings will be accompanied by dredgings, and that they will be carefully made, as much of Dr. Carpenter's early researches in deep-sea dredging, which excited so much attention at the time and since, were made in the neighbourhood of the Faroe Islands.

THE earthquake in California on March 26 appears to have been felt over a very large area, and in some places to have been very severe. At Leone Pine, in the country north of the Mojane river, twenty-three people were killed, and thirty wounded; fifty large houses were destroyed, and the town is in ruins. Similarly Camp Independence, Inigo county, is in complete ruins, the earthquake having been most severe in that region. Large fissures are reported, miles in length, and 50 to 200 feet wide, and twenty feet deep, opened along the eastern base of the Sierra Nevada, near Big Pine Camp. At other places in the vicinity, the ground is heaved up in great ridges; large springs have stopped running, and others have broken out. Heavy snow slides have occurred in the Sierras, and large rocks rolled down the mountain side, blocking up the road. The shocks lasted at intervals from 2.20 to 6.30 A.M. Many people at Camp Independence were hurt, but none were killed. The shock was probably the heaviest south-eastward towards Arizona, in the desert country which has hardly any population.

THE April number of the *American Journal of Science* contains an account by Prof. Marsh, the indefatigable palæontologist, of his discovery of a new species of *Hadrosaurus*, a giant lizard; one of which, found in New Jersey, from its enormous size, constitutes one of the chief attractions of the Academy of Sciences of Philadelphia, where it is deposited. The present animal is scarcely one-third the size of the New Jersey specimen. It was discovered near the Smoky Hill River, in Western Kansas, and is named *Hadrosaurus agilis.*

ON THE MINERAL CONSTITUENTS OF THE BREITENBACH METEORITE *

THE Siderolite of Breitenbach was acquired for the British Museum in the year 1863. It was found (in 1861) at Breitenbach in Bohemia, at a spot not very far distant from the Saxon frontier, or indeed from Rittersgün, in Saxony, a place in which a very fine mass that bears a close resemblance to the Siderolite of Breitenbach, was almost contemporaneously found. A little way to the west of the centre of the line joining Rittersgrün and Breitenbach lies Steinbach, a village in the environs of Johanngeorgenstadt, near Schwartzenberg; and here in 1751 was also found a mixed meteoric mass in which, as in the two already mentioned, iron, sponge-like in its structure, encloses siliceous minerals that do not present a familiar aspect. The three meteorites are, in fact, so similar to one another and so dissimilar to any others in European collections, that there can be little doubt they belonged originally to the same meteoric fall.

Stromeyer † in the year 1825 examined a siderolite in which he found as much as 61·8 per cent. of silica. This remarkable result, together with the numbers of his analysis, he interpreted as indicating the presence of a magnesian trisilicate, probably meaning thereby a sesquisilicate (magnesium epideutosilicate). The specimen which he analysed he described as coming from Grimma, in Saxony. This specimen was, in fact, a portion of a mass preserved in the collection of the Duke of Gotha, and doubtless believed by Stromeyer to be a portion of a stone which was known to have fallen in the middle of the sixteenth century in a wood near Naunhof, in the neighbourhood of Grimma. Chladni‡, however, held this view to be untenable, grounding his opinion on the completeness of the meteorite preserved at Gotha, both as regards its form and its crust, while he adds that the Naunhof mass must have been far too great to allow of its being transported, and, indeed, that it had never been rediscovered. It is in every way probable that the material Stromeyer really had taken to work upon was from a Saxon locality, and in fact a specimen from a fall, to which the Rittersgrün and Breitenbachasiderolites belong. Breithaupt§ believes the fall in question to have been the "*Eisenregen*" which occurred at Whitsuntide, 1164, in Saxony, when a mass of iron fell in the town of Meissen ‖.

An inspection of a polished surface of either of these masses reveals the iron in patches of irregular form, which exhibit the characteristic crystalline structure of meteoric irons when etched. The interspaces are partly filled by meteoric pyrites (troilite) in small patches, recognisable by its pinchbeck brown colour, the rest of the surface being occupied by a greenish and greyish-brown crystalline magma. It is of the ingredients of the last-mentioned portion of the meteorite that I shall first speak. On treating the whole mass with mercuric chloride at 100° for some hours the iron and the troilite are dissolved, and the magma before alluded to remains unattacked. But it has now lost its compound structure, and is found to consist of three substances: (1) highly crystalline, bright green, or else greenish-yellow grains; (2) rusty brown, sometimes nearly black, sometimes also nearly colourless grains of a mineral that presents crystalline features, but on which definite crystalline planes are of great rarity; and (3) crystalline grains of chromite.

The first of these three minerals proved to be a ferriferous enstatite, or bronzite; the second is a mineral which corresponds in all respects, except its crystalline form, with the tridymite of Prof. Vom Rath. In respect of their forms, however, it is difficult to suppose that the two minerals are identical.

Bronzite of the Breitenbach Siderolite

The specific gravity of this mineral is 3·238, that of the silicates in the Steinbach siderolite, as determined by Stromeyer, having been 3·276, and as estimated by Rumler 3·23. The hardness is 6.

The blackened aspect of some of the bronzite was due to a mere superficial coating of iron oxide, arising doubtless from the oxidation of a portion of the nickeliferous iron. It was invariably found that this film was easily removed by hydrogen chloride, leaving the bronzite of a bright green colour, and that the action of the acid on the mineral extended no further.

Two analyses of this mineral were made, the one by the hydrogen fluoride method of distillation*, the other by fusion with mixed alkaline carbonates, and the results were as follow:—

	I.	II.	Mean.	Oxygen.
Silicic acid . . .	56·101	56·002	56·051	29·89
Magnesium oxide .	30·215	31·479	30·847	12·34
Iron protoxide . .	13·583	13·295	13·439	2·97
	99·899	100·776	100·337	

These numbers correspond very closely with the formula $(Mg_{\frac{4}{5}}\ Fe_{\frac{1}{5}})\ Si\ O_3$.

Asmanite—a new mineral, being Silica crystallised in the Rhombic System, as a Constituent of the Breitenbach Siderolite.

The second mineral associated with the bronzite in this meteorite is free silica, possessing the lighter specific gravity presented by quartz after fusion, and crystallised in forms that belong to the orthorhombic system. To this mineral, which is distinct in its system and forms from the tridymite of Vom Rath, I propose to give the name Asmanite, A'sman being the Sanscrit term (corresponding to the Greek ἄκμων) for the thunderbolt of Indra. In bulk it forms about one-third of the mass of mixed siliceous minerals. The grains of this mineral are found mixed with those of the bronzite, after the iron, the troilite, and the chromite have been removed. They are very minute and much rounded, and, though entirely crystalline, they very rarely indeed present faces that offer any chance for a result with the goniometer; indeed out of the several thousands of these little grains comprised in some two grammes that were isolated of the mineral, it was only possible to find with a lens about a dozen specimens with sufficiently distinct crystallographic features; and of these only four or five proved to bs available for examination and comparison. In several, however, the optic axes were plainly to be distinguished when properly examined with a Nörrenberg's polarising microscope; and by this means the angles given by planes belonging to zones otherwise too incomplete for a reliable result were brought into comparison on different crystals.

The parametral ratios of Asmanite are

$$a : b : c = 1{\cdot}7437 : 1{\cdot}0000 : 3{\cdot}3120.$$

The faces of the octaid forms are almost invariably rounded. Fair approximate measurements, however, of three of the tantozonal faces in one crystal were obtained.

That the mineral belongs to the rhombic and not to an unaxial system is emphatically evidenced, independently of the measurements, by its optical characters, as shown in its very distinct and widely separated optic axes. As has been said, the first mean line is the normal of the face 1 0 0, that to face 0 0 1 is the second mean line. The first mean line is parallel to the axis of least optical elasticity, so that the crystal is positive in its optical character. The apparent angle, as measured in air, of the optic axes was approximately determined as 107° to 107° 30′. The axes for the red rays are slightly more dispersed than those for the blue.

The crystalline grains which constitute this ingredient of the meteorite, when first obtained, are of a rusty brown and sometimes even black colour; treatment for a short time with dilute hydrogen chloride, however, entirely removes this iron stain and leaves the granules in a state of colourless purity, in which state they are readily distinguished from the grains of the accompanying bronzite.

The specific gravity of the mineral gave the number 2·245. Its hardness is 5·5.

Two analyses were made by different methods, and the results are given below.

I. 0·3114 substance, distilled with pure hydrogen fluoride, gave 1·1136 gramme of potassium fluosilicate, 0·0035 gramme iron oxide, 0·0018 calcium oxide, and 0·0132 gramme magnesium phosphate.

These determinations denote the following percentages:—

Silicic acid	97·43
Iron oxide	1·124
Calcium oxide	0·578
Magnesium oxide	1·509
	100·641

* Abridged from a paper contributed to the Philosophical Transactions by Prof. Maskelyne, F.R.S.

† Pogg. Ann. iv. p. 195

‡ Berg. und. Hutt, Zeitung, xxi. p. 322

§ Feuer-Meteore, pp. 326 and 212

‖ Feuer-Meteore, p. 198

* Philosophical Transactions, 1870, p. 189.

II. 0·2653 gramme of carefully selected substance, evaporated with an excess of ammonium fluoride, left 0·0021 gramme residue, chiefly iron oxide.

This determination denotes the following percentage composition:—

Silicic acid	[99·21]
Iron oxide, &c. . . .	0·79
	100·00

Besides the distinct cleavage parallel to the plane 0 0 1 already alluded to, and the other, less distinct, parallel to the planes of the form (1 0 1), there seem also to be divisional planes or, rather, surfaces along which the crystals break up with the greatest facility; even drying them on blotting-paper proving often sufficient to destroy the integrity of specimens that might otherwise seem to promise good results to the goniometer.

Partsch,* in his description of the Vienna Collection of Meteorites, identifies as a specimen of the Steinbach siderolite a fragment with a label, "Native iron, jagged and hackly, with quartz in grains and a yellow fluor-spar" (*gediegenes, zahnicht und zackicht gewachsenes Eisen mit körnichtem Quarz und gelblichtem Flussspath*).

Breithaupt†, in his paper describing the Rittersgrün Siderolite, makes its chief silicate to be peridot. It is doubtless bronzite. In addition to troilite and schreibersite, he records the presence of "another mineral, the composition of which is not yet determined."

It should be mentioned that, with a view to test the relative solvent action of alkaline carbonates on quartz and the meteoric silica, weighed portions of each were digested with a ten per cent. solution of sodium carbonate for ten hours at 100° C. under precisely similar conditions. Of the quartz 7·843 per cent. had dissolved, of the Breitenbach silica 9·437 per cent.

The Shalka Meteorite.

An examination of the Shalka meteorite, also detailed in the same memoir, gave as a result that this meteorite consists mainly of a bronzite of the formula $Mg_{\frac{3}{4}} Fe_{\frac{1}{4}} Si O_3$, and is therefore identical in composition with, though very different in appearance and structure from, that of the meteorite of Manegaum.

HEAT GENERATED BY METEORIC STONES IN TRAVERSING THE ATMOSPHERE

As supplementary to my short article on the "Maximum Velocity of Meteoric Stones Reaching the Surface of the Earth" (NATURE, Sept. 14, 1871, vol. iv. p. 398), permit me to add the following observations in relation to the source and the amount of the heat generated by such masses in traversing the atmosphere.

It is well known that the observations of Glaisher, Petit, Daubrée, and others, establish the fact that these bodies enter our atmosphere with velocities which are truly planetary. For example, the meteorite of Orgueil moved with a velocity of at least 20 kilometres (12·43 miles) per second, while in other cases velocities have been observed which could not be observed at less than from 15 to 30, or even 40 miles per second. The enormous resistance encountered by such bodies in traversing the air (as we have seen in the previous article), speedily extinguishes this high velocity, so that they retain but a comparatively moderate velocity on reaching the surface of the earth.

Now, the "Dynamical Theory of Heat" assures us that whatever energy is lost by the moving body is transformed into heat, which is either retained by the body or is communicated to the air. The amount of heat thus generated can be estimated, provided the diminution of velocity and the mass of the meteoric stone are known. More than 23 years ago Dr. Joule pointed out this transformation of energy into heat as the true cause of the ignition of these extra-terrestrial masses in traversing the air (*Vide* Phil. Mag., 3rd Series, vol. xxxii., p. 349, May 1848).

According to Joule's experiments, one French unit of heat = 423·5424 kilogrammetres or units of energy. Hence, one

$$\text{French unit of energy} = \frac{1}{423 \cdot 5424} = 0{\cdot}00236104 \text{ French units of heat.}$$

If, therefore,

v = velocity of stone upon entering the atmosphere,
v_1 = ,, ,, ,, when near the earth's surface,
g = acceleration produced by gravity,
w = weight of moving stone in kilogrammes:

Then if v, v_1, and g are taken in metres per second, we have,

$$\text{Loss of energy} = w \cdot \frac{v^2 - v_1^2}{2g}.$$

This loss of energy transformed into heat =

$$0{\cdot}00236104 \times w \cdot \frac{v^2 - v_1^2}{2g} \text{ French units of heat.}$$

Assuming $g = 9{\cdot}80942$ metres per second, we have,

French units of heat generated $= 0{\cdot}000120345 \times w \times (v^2 - v_1^2)$.

This gives the total amount of heat evolved by the loss of energy.

Now, if we knew the distribution of the heat thus generated, it would be easy to estimate the increase of temperature which it would occasion in the matter to which it is imparted. If we assume all of the heat evolved to be retained by the moving body, it is evident that the increase of temperature ($v^2 - v_1^2$ being the same) is inversely proportional to the product of the weight into the specific heat of the moving mass.

Hence, if c = specific heat of stone in relation to water as unity, we have,

$$\text{Increase of temperature in C}^\circ = 0{\cdot}000120345 \times \frac{w(v^2 - v_1^2)}{w \times c}; \text{ or}$$

$$\text{Increase of ,, ,,} = 0{\cdot}000120345 \times (v^2 - v_1^2) \times \frac{1}{c}. \quad (a)$$

Under the assumption that all of the heat generated is retained by the moving mass, it is obvious that w is eliminated; for, while the heat evolved varies as w, the mass to be heated also varies as w; so that the weight is without influence, in so far as increase of temperature is concerned.

In order to apply this formula to any given case, we must know v, v_1, and c in relation to the moving stone. Perhaps we should not be over-estimating v by assuming it to be 30 kilometres per second, or nearly equal to the velocity of the earth in its orbit. In like manner we should certainly not be underestimating v_1 by assuming it equal to 500 metres per second. Substituting these values in formula (a), and we have,

$$\text{Increase of temp. in C}^\circ = 0{\cdot}000120345\,(30000^2 - 500^2) \times \frac{1}{c}; \text{ or}$$

$$\text{Increase of ,, ,,} = 108530 \times \frac{1}{c}.$$

Finally, in the absence of experimental results in regard to the specific heat of meteoric stones, we are certainly not underestimating c by assuming it equal to 0·22.

Substituting this value of c in the last equation, and we have,

Increase of temp. in C° = 492,184°.

Of course, by far the larger portion of the heat generated by the loss of energy of the moving stone would be imparted to the air along its trajectory; but assuming that only $\frac{1}{100}$th part of it is retained by the stone, it would be more than sufficient to account for the phenomena of fusion and detonation which frequently accompany the transit of such bodies through our atmosphere.

In the case of small masses, it is clear that their high velocities would be more rapidly extinguished by the resistance of the air than is the case with large masses. In the small mass the transformation of energy into heat being accomplished in a shorter time, a greater amount of the evolved heat would be retained by the stone than in the large mass whose velocity is more gradually checked by the resisting medium.

Hence, when the smaller masses plunge into the upper atmosphere, the matter may be volatilised or utterly dissipated by the intensity of the suddenly-evolved heat. In this minutely-divided condition the material of the stones would float about in the atmosphere, and ultimately reach the surface of the earth in the form of meteoric dust.

It is well known that the observations of Benzenberg, Quetelet, Herrick, Newton, and others, assign to the so-called "falling stars" velocities equal to, if not surpassing, the velocities of meteoric stones. According to the foregoing suggestion, these may be nothing more than small meteoric stones which are volatilised in the upper regions of the atmosphere long before reaching the surface of the earth.

Thus, the phenomena of the occasional fall of meteoric stones and the almost incessant appearance of the falling stars which nightly furrow the celestial vault, may be correlated with the

* Die Meteoriten im k. k. Hof-Mineralien-Kabinette. Wien, 1843, p. 95.
† Berg und Hütt. Zeitung, xxi. p 321.

principle of transformation of energy. At all events, all the luminous, thermic, and detonating phenomena attending the fall of such bodies seem to be fully accounted for by the enormous amount of heat thus generated by their passage through the atmosphere.

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SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie, November 1871. This number opens with a lengthy paper by Græbe and Liebermann on anthracene derivatives; they have studied in detail anthracene carbonic acid, and the behaviour of anthraquinine with phosphoric chloride and potassic hydrate. They have also experimented with the anthraquinine sulpho acids; at the present time researches on this subject possess considerable technical interest, as it is from disulphanthraquinonic acid that artificial alizarin is prepared, which seems to be fast supplanting the use of the madder root in dyeing. Böttger and Petersen follow on a subject nearly allied to the former, "on the compounds of anthraquinone containing nitrogen." Zinneman contributes a paper on an improvement in the method of distillation; the method is somewhat similar to that usually employed in chemical laboratories, that is to cause the vapour to pass up a long upright glass tube on which several bulbs have been blown, the exit tube being at right angles nearly at the top; the new portion of the apparatus consists in placing in the long tube a number of bell-shaped cages made of platinum wire gauze, which fit closely to the sides of the tube, and through which the vapour must pass or filter as it rises in the tube. With this apparatus the author has made an extensive series of experiments on the purification and determination of the boiling points of some of the most important of the ethyl compounds, on various acids of the same series, on the separation of propyl and butyl alcohols from the products of fermentation, and on the separation of the iodides of ethyl, propyl, and butyl. Judging by the results of these experiments, the new contrivance seems to work extremely well, and to be an improvement on the original form of apparatus. Several short papers complete this number, but they are not of extreme interest.

Journal of the Chemical Society, March 1872.—The composition of the natural tantalates and niobates forms the subject of a very important paper by Rammelsberg. Numerous analyses of various minerals containing the two rare elements, tantalum and niobium, are given, the results of which, however, cannot be usefully condensed.—Dr. Tilden presents a note "On the crystalline principle of Barbadoes Aloes;" the author has obtained a chloro-substitution product corresponding to the bromo-derivative, described some years since by Dr. Stenhouse, that is aloïn in which three atoms of hydrogen are replaced by chlorine. The remainder of this number is occupied by the abstracts of foreign papers, many of which are of great interest.—Dr. de Coppet finds that supersaturated solutions of sodic sulphate can be prepared by dissolving the anhydrous salt in cold water; it is, however, necessary that the anhydrous salt should be heated above 33°, and cooled out of contact with the air, as it is found that the anhydrous sodic sulphate, obtained by drying the ordinary salt (containing ten molecules of water) at a temperature lower than 33°, always acts as a nucleus in determining the crystallisation of a supersaturated solution of this salt. From this it appears that from crystallised sodic sulphate different bodies are obtained depending on the temperature at which the salt is dried.—A long abstract of Linnemann's important paper "On an improvement in the method of fractional distillation," and also of his researches on the normal propyl alcohol and its compounds are here given.—Another curious example of the lowering of the boiling point of mixtures of water and other liquids forms the subject of another abstract. Is. Pierre finds that a mixture of water and butyl iodide distils at 95°–96° (butyl iodide boils at 122·5°), and that a constant mixture of 79 parts of iodide and 21 of water is found in the distillate. Ethylic iodide (B.P. 72°) and water distil at 66°, only 3 to 4 per cent. of water condensing with the iodide. The abstracts as a whole are shorter and more condensed than they were originally; in some cases this must be regretted, though in others it is, perhaps, an advantage.

THE *Quarterly Journal of Microscopical Science* for April 1872, contains memoirs on the Development of the Enamel in the Teeth of Mammals, as illustrated by the various stages of growth demonstrable in the evolution of the fourth molars of a young elephant, and of the incisor teeth in the fœtal calf, by Prof. Rolleston, M.D. This paper is a reprint.—Note on Immersion Object-glasses for the Microscope, by Dr. Royston Piggott, chiefly directed towards the assertion that the aperture of an immersion lens can never exceed 80°, which this author denies.—Observations of Pathological Changes in the Red Blood-corpuscle, by J. Braxton Hicks, M.D.—On the Artificial Production of some of the principal Organic Calcareous Formations, by Prof. Harting, of the University of Utrecht. This is an abridged report of researches undertaken with the view of producing, independently of living organisms, certain calcareous formations, which are met with in animals as integral parts of their skeleton, and this by causing calcium carbonate and phosphate to combine in the nascent state with organic substances.—On the Peripheral Distribution of Non-medullated Nerve-Fibres, by Dr. E. Klein; the third part of a memoir, of which the previous portions appeared in this journal. It treats of the relation of the non-medullated nerve-fibres to small arteries, small veins, and to capillary vessels in the muscular substance of the frog's tongue; and the termination of nerve-fibres in the ciliated duct in the tail of the rabbit.—On the Structure of Tendon, by J. Mitchell Bruce, partly in support and partly in con-troversion of the views of Boll, as detailed in Max Schultze's *Archiv*.—The Embryology of Chrysopa, and its bearing on the Classification of the Neuroptera, by A. S. Packard, Jun., M.D. Reprinted from the *American Naturalist*.—Preliminary notice of Researches on the Anatomy of the Serous Membranes in Normal and Pathological Conditions, by Dr. E. Klein and Prof. Burdon Sanderson, forming a part of investigations on infectious diseases, undertaken for the Medical Department of the Privy Council. These investigations relate to more than 250 animals, especially rabbits and guinea pigs, many frogs, several cats, dogs, some rats, and one monkey.—The remainder of the journal is occupied with abstracts, notices, and reports.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 16.—"On the Specific Heat and other physical characters of Mixtures of Methylic Alcohol and Water, and on certain relations existing between the Specific Heat of a Mixture or Solution, and the Heat evolved or absorbed in their formation," by Dr. A. Dupré.—"On Supersaturated Saline Solutions," Part III., by Charles Tomlinson, F.R.S., and G. Van der Mensbrugghe.—"Remarks on the Sense of Sight in Birds, accompanied by a description of the Eye, and particularly of the Ciliary Muscle in the genus *Raptores*," by Mr. Robert Lee.—Supplement to Mr. Lee's communication on the Sense of Sight in Birds. A Description of the Eye in *Rhea americana*, *Phœnicopterus antiquorum*, and *Aptenodytes Humboldtii*.

Geological Society, May 8.—Mr. Joseph Prestwich, F.R.S., in the chair.—The following papers were read:—1. "Notes on Atolls or Lagoon Islands." By Mr. S. J. Whitnell. The author commenced by indicating certain facts which lead him to think that the areas of atolls are not at present sinking, and referred to one instance (that of Funafuti or Ellice Islands), in which he thought there were signs of a slight upward movement. He noticed the occurrence of a furrowed appearance, or a series of ridges or mounds, in some islands, each of which he regarded as produced by a single gale. He also described a freshwater lagoon, about three miles in diameter, as occurring in the Island of Quiros. Mr. Thorpe was acquainted with the atolls around the coast of Ceylon, and thought that the local traditions, untrustworthy as such sources usually were, might afford some evidence as to the date of their origin. The tradition of Ceylon was that the Maldive and Laccadive Islands had within the memory of many been connected with Ceylon. If this were so the evidence was in favour of the area being one of subsidence. Mr. D. Forbes, when in 1859 he spent some months in the Pacific, had been requested by Mr. Darwin to examine into the evidence as to the origin of these atolls by elevation, and had found that the asserted cases of the existence of masses of coral at a considerable elevation above the sea merely arose from blocks having been transported inland by the natives. Though, however, there was no evidence of elevation, it was still possible that such had in certain cases taken place, as there were still active volcanoes in this region. The freshwater lakes he attributed to the drainage of the islands

2. "On the Glacial Phenomena of the Yorkshire Uplands." By Mr. J. R. Dakyns. The author stated that in Derbyshire and Yorkshire, south of the Aire, there is no glacial drift on the eastern slope of the Pennine chain, except where it is broken through by the valleys of the Wye and of the Aire and Calder. The basis of the Aire and the country northward are thickly covered with drift, which contains no rocks foreign to the basis, and thus points to formation by local action. The author ascribed this to the glaciation of the country in part by glaciers, and in part by a general ice-sheet. Evidence of the latter he finds in the fact that drift occurs only on one side of the valleys, namely, on the lee-side of the hills with respect to the source of the drift materials. Traces of the action of glaciers are the great amount of scratched and rounded pebbles in the mounds of drift, which increases in proportion to the distance from their source: the presence of great piles of drift at the junction of valleys, as if by the shedding of the lateral moraines of two glaciers; and the existence of mounds of pebbles and of an alluvial deposit wherever a rock-basin crosses a valley. The Kames or Eskers, which are frequent in the valleys, he ascribed to the deposition of moraines in the sea instead of on land. Prof. Ramsay agreed with the author as to the existence of these rock-basins in the Yorkshire area, and as to the absence of marine drift on great part of the slope of the Pennine chain. The terminal moraines had to some extent become obscured by the washing of soil by rain; but their ancient existence in many of the Yorkshire valleys was indisputable. The features of the country, were, moreover in many instances such as could not be reconciled with the deposition of the drift by marine action. 3. "On a Sea-coast Section of Boulder-clay in Cheshire." By Mr. D. Mackintosh, F.G.S. The principal object of the author was to draw attention to the fact of the occurrence of numerous sea-shells in a lower boulder-clay at Dawpool, as thoroughly glacial in its appearance, structure, and composition, as any clay to be met with along the shores of the Irish Sea, and differing in no essential respect from the *Pinel*, which runs up the slopes and valleys of the Lake District. He pointed out a number of very important distinctions between the Lower and Upper Boulder-clays of Cheshire, referring especially to the light grey or blue facings of the fractures of the latter. He gave a list of a number of large boulders, greenstone and Criffell granite predominating, though among the smaller stones Silurian grit was most prevalent. The author likewise explained the mode of striation of the stones found in the clay, and the position they occupied in reference to their flattened surface. The paper was illustrated by samples of the two clays, a number of shells in various states of preservation, and about forty specimens (most of them named and their parentage assigned) of Silurian grit and argillite, greenstone, several varieties of felstone and porphyry, felspathic breccia, Criffell and Eskdale granites, and granites of unknown parentage, Wastdale or Ennesdale syenite, quartz, Carboniferous Limestone, chalk-flints (?) local gypsum, sandstone, &c. In a letter Mr. Searles V. Wood, Jun., stated that he regarded the Boulder-clay containing the shells as later than the newest of the East-Anglian beds, and the Upper clay as probably equivalent to the Hessle clay. The fragmentary shells sent had been determined by Mr. J. Gwyn Jeffreys, who found eleven species represented among them, and stated that they agreed with the shells from Moel-Tryfaen and Macclesfield. He remarked especially on the occurrence of *Astarte borealis*, a species now extinct in the British area. Prof. Ramsay remarked, with regard to the Bridlington beds which had been cited, that they were probably preglacial, and not glacial. He thought that eventually it would be proved that during the Glacial Period there had been several oscillations in this country both in level and temperature. With respect to temperature, the calculations of Mr. Croll showed the extreme probability of such variations being due to astronomical causes; and these were best illustrated by reproducing his figures in the form of a diagram, showing the curves and oscillations of temperature. 4. "On Modern Glacial Action in Canada.—II." By the Rev. William Bleasdell, M.A. In this paper the author communicated some facts illustrative of the action of ice in Canada, in continuation of a former paper. Fidlar's Island, in the rapids of the river Trent (flowing into the head of Lake Ontario), has been removed within the last eighteen months. Patrick's Island, a mile lower down, is also rapidly disappearing. Salmon Island, in the Bay of Quinte, between Amherst Island and the mainland, which had an area of about an acre fifty years ago, has disappeared, leaving a shoal with about four feet of water over it; and three neighbouring islets, known as The Brothers, are in course of removal. The removal of these islands is due to the action of drift-ice. The author also referred to the formation of ground-ice in the Canadian rivers. Prof. Ramsay mentioned that Sir William Logan had informed him that shore-ice in Canada, charged with boulders, had been known to produce grooves on the face of cliffs as well marked as those of glacial times. He had also mentioned the case of a boulder transported by ice which was of such a size as to have occasioned the wreck of a vessel which had struck upon it.

Mathematical Society, May 9.—W. Spottiswoode, Treas. R.S., in the chair.—Mr. J. W. Glaisher gave an account of his paper "On Functions with Recurring Derivatives." Mr. Tucker (Hon. Sec.) read portions of communications from Prof. J. Clerk Maxwell, on Equations of Motion, and on the Transformation of Solids.—Prof. Clifford made some remarks on a theory of the exponential function derived from the equation $\frac{du}{dt} = pu$. Prof. Cayley, Dr. Hirst, Mr. S. Roberts, and others, took part in a subsequent discussion on the degenerate forms of curves.

Chemical Society, May 16.—Dr. Debus, F.R.S., vice-president, in the chair.—"On the Influence of Pressure upon Fermentation," Part I., by Mr. H. T. Brown. The results of his experiments were that under diminished pressure the amount of gas unabsorbed by potash is greatly increased, and that it contains a proportionally large amount of hydrogen. Acetic acid and aldehyde are also formed under these circumstances, so that it would seem that water is decomposed during the alcoholic fermentation, especially when it takes place under diminished pressure. Papers "On the Electrolysis of Sugar Solutions," by Mr. H. T. Brown; "On the determination of the solubilities and specific gravities of certain Salts of Sodium and Potassium," by Messrs. D. Page and A. D. Keightley; and "An examination of the recent attack on the Atomic Theory," by Mr. Atkinson, were then read. An animated discussion on the Atomic Theory ensued. Mr. C. O'Sullivan then read his elaborate memoir "On the transformation products of Starch."

Anthropological Institute, May 20.—Dr. Charnock in the chair.—Mr. J. Bonomi exhibited and described a new instrument for measuring the proportions of the human body, being specially applicable to the identification of criminals, and adapted for a rapid and very easy method of measurement in military and other large establishments.—A paper was read by Mr. George Harris, V.P., "On Moral Irresponsibility resulting from Insanity." He concluded that persons are not responsible for their actions in cases where they labour under delusions to such an extent that their conduct is not only influenced, but determined, by their belief, although they may still continue to reason correctly. Irresponsibility should be allowed also in those cases where they are impelled by irresistible morbid impulses; and where from disorders of the nervous system they are suffering from violent and uncontrollable irritability. He criticised the legal definition of irresponsibility in cases of that nature. As to suicide affording a proof of insanity, that must depend on the circumstances of each particular case. The author pointed out the contradictory theories laid down respecting insanity, and alluded also to the conflicting opinions expressed by medical men.

Geologists' Association, May 3.—James Thorne, F.S.A., vice-president, in the chair. "On Columnar Basalts," by Mr. John Curry. As a preliminary, the process of the formation of columnar mud was briefly described, the analogy between this process and that of the formation of columnar basalt being such that the same diagrams served for illustrations in both cases, though, in the former case, heat penetrates the fine clayey sediment, and produces columns of dried mud; in the latter, cold advances into the molten lava, and changes it into solid rock, which frequently has a rude but sometimes a perfect columnar structure. Hexagonal columns are the most perfect. In reference to the production of these columnar structures, the chief and most notable conditions are unequal temperatures, which the author designated heat and cold, closely situated at the contact surfaces of dissimilarly constituted bodies. In the above instances the dissimilar bodies in surface contact are, first, the atmosphere and fine clayey sediment; second, the oceanic water and the molten lava. While the solidifying of the lava is being effected, the solid and molten parts may be considered as distinct bodies. It is at and near the surface contacts that the exchanges of heat are most efficient in giving structure to the forming body. The actions of heat and cold, having a directive influence in the formation of hexagonal basaltic columns, were shown in the illustrations. In the concluding part of the paper the large surface contact of the ocean with the bed on which it rests, and the contact of the atmosphere with the land and water surfaces, were adverted to as areas where the exchanges of heat had done and were now doing much work in producing structures. Jointage, cleavage, and various other rock-structures are ascribed as being mostly due to such work. Ice structure is another marked example. It bears a striking analogy to the hexagonal columnar structure of basalts, inasmuch as it often breaks up into columns by slow melting. The ice of a lake sometimes shows such a breakage when it melts in the spring.—"On a visit to the Diamond Fields of South Africa, with notices of geological phenomena by the wayside," by Mr. John Paterson. On the geological questions connected with th diamond fields the author propounded some new views based on a minute and careful examination of the appearances which presented themselves to him on his visit to the diamond-fields. He discredits the theories which would refer the presence of diamonds in Grequaland West to any distant sources; and thinks the evidence incontestable that the marl soil, as he named it, in which the gems are now found, is the true matrix soil of the diamond. This marl soil he considers to be the metamorphosed carboniferous shales of the country, and the change which has worked upon these shales, by which they have been transformed from the black carboniferous shale into the whitish ashy marl in which the diamonds are found, he attributes to intrusions of greenstone trap, which traverse that country from N.E. to S.W. in continually recurring dykes. Mr. Paterson gave some very interesting details of the extent and richness of the diamond diggings in South Africa, and in his picture of the Gong-Gong and Delport Diggings as "Great Rushes" in digger's phrase, resembling in extent and richness Colesberg Kopje, but now nearly worked out, not by the hand of man in a few years, but by the angry waters of the Vaal River through many ages, he found much groundwork of hope that the diamond discoveries of South Africa are to be no fleeting passing industry, but a continuous employment, not only for many years but for many ages.

Society of Biblical Archæology, May 7.—Mr. R. Cull, F.S.A., in the chair.—"On Underground Jerusalem; more particularly in reference to the Plateau of the Haram es Shereef." By Mr. William Simpson. The paper described Omar's search under the guidance of Sophronius, the patriarch of Jerusalem, for the site of the Temple, as one of the first explorations into the topography and archæology of the Holy City. The transference of holy places from one point to another was explained as involving confusion and adding to the difficulties of arriving at reliable facts. The principal theories respecting the site of the Temple and the Holy Sepulchre were defined, and their merits touched upon so far as to indicate the progress of the questions connected with them. The importance of a careful study of the various styles of building in the Haram Wall was pointed out so as to get a date, if possible, as a ground upon which to start. A most interesting part of the paper was a description of the Great Sea, excavated out of the solid rock, under the Temple site, and the supply of water to it from the pools of Solomon near Bethlehem. The great importance of the water system for the Temple uses having an essential bearing on the question of the topography, and the question was still one which required further knowledge and study to arrive at a definite result.—"On the so-called Moabite Stone, described in a late Letter to the *Times*." By Mr. B. G. Jenkins. The author considered that the letter and the inscription bore their own condemnation; for the stone could not be Moses' memento of the conquest of a land he never attacked.—"Observations on the dimensions of the Great Pyramid and the Royal Coffer." By Solomon M. Drach.

PARIS

Academy of Sciences, April 29.—M. Chasles read a paper containing theorems relating to the obliques drawn through the points of a curve under angles of the same size.—M. F. Lucas communicated some general theorems on the equilibrium and movement of material systems.—M. L. Melsens presented a note on some effects of the penetration of projectiles into various media, and on the impossibility of the fusion of leaden bullets in the wounds produced by fire-arms.—A memoir was read on the electrical jet in rarefied gases, and especially on its mechanical power, by MM. A. de la Rive and Sarasin. Their experiments showed that the velocity of rotation of the jet diminishes as the density of the gas is increased, but not in the same proportion, and that the jet possesses considerable mechanical force.—MM. P. A. Favre and C. A. Valson presented a continuation of their memoir on crystalline dissociation, containing the second part of their investigation of the alums.—M. Fizeau presented a report on a memoir by M. Croullebois on the elliptical double refraction of quartz.—A continuation of M. P. Desains' researches upon the reflection of heat was read, and a note by M. D. Gernez on the absorption-spectra of selenium and tellurium, their protochlorides and protobromides, and of the protobromides of iodine and alizarine were presented by M. H. Sainte-Claire Deville.—Several papers and notes on auroras were read, including the continuation of M. J. Silbermann's memoir on the causes and laws of auroras, a note by Father Denza on auroral phenomena observed in Italy in March and April 1872, and a note by M. Guillard on indications of an aurora borealis observed at Lyons on April 8.—A second note by M. W. de Fonvielle on the hypothesis of the magnetisation of the sun was also read.—M. Delaunay presented a note by M. G. Héraud on the tides of lower Cochin China, with especial reference to the determination of the diurnal and semi-diurnal waves.—A note by M. Chapelas on a meteor observed at Rheims on the night of April 19-20, and one by M. Perris on a meteor seen at Agde on the evening of April 24 were read.—M. Aimé Girard presented an investigation of the salt marshes and salt industry of Portugal, in which he describes the details of the extensive manufacture of sea-salt carried on in that country.—M. Bussy presented a note by M. J. Personne on the presence of selenium in the sulphuric acid manufactured in France.—A note by the Abbé Laborde on the action of oxygen upon certain vegetable infusions was communicated by M. Pasteur. The author, after hermetically sealing a vegetable infusion in a glass vessel, and keeping it for a month unchanged, produced from it successive small quantities of oxygen by electrolysis. The infusion still remained unaltered, notwithstanding the replacement of the vacuum by an atmosphere of oxygen; but when the vessel was opened to the air vegetation soon made its appearance.—M. Pasteur also communicated a note by M. Griessmayer on the question of the assimilation of ammonia by yeast.—A note by M. H. Byasson on the physiological action of formic æther was presented by M. Robin.—M. Blanchard presented a note on the appearance of unusual numbers of *Bibio hortulanus*, a dipterous fly, in Paris.—A paper by M. P. de Gasparin on the constitution of clays was read. This paper contained an analysis of a very fertile clay soil from near Nîmes.—M. de Quatrefages communicated a note by M. E. Rivière on the human skeleton discovered in the caverns of Boussé-Roussé, in Italy, on March 26, 1872. This skeleton, which was associated with unpolished flint implements, presents no simian characters, and the cranium most nearly resembles those of Cro-Magnon.

May 6.—M. Chasles presented a note by M. H. Durrande on the general properties of the displacement of a figure of variable form.—A note by M. T. D'Estocquois on the movement of water in drains was read.—M. J. Bourget read a memoir on the economic coefficient in the thermodynamics of permanent gases.—M. Wurtz presented a note by M. G. Salet on the light emitted by the vapour of iodine, in which the author stated that that vapour may be heated to redness.—A letter from M. Tacchini to M. Faye, with regard to the Society of Italian Spectroscopists, and a reply to some of the statements contained in it by M. Faye, were read. They contained a discussion of various matters connected with our knowledge of the sun.—A note on atmospheric ozone by M. L. Palmieri was presented by M. C. Sainte-Claire Deville. The author stated that air, by passing through a glass tube, ceases to colour iodised starch paper. M. Sainte-Claire Deville confirmed this statement from M. Houzeau's observations.—A letter from M. Donati on auroras was communicated by M. Delaunay.—M. Le Verrier presented a note by Father Denza on a sand-shower which fell in Italy during the night of the 19-20 April.—A letter by M. Silbermann on the relations between meteorological phenomena and volcanic eruptions was read.—A note was read by M. C. Daniel on a process of decorative painting upon tin, and on this M. Dumas made some remarks.—M. Frémy presented a note by M. Prinvault on the transformation of pyrophosphates into phosphates by the action of boracic and sulphuric acids.—A note by M. Yvon on the quantitative determination of copper by cyanide of potassium was communicated by M. Bussy. This note relates to one on the same subject by M. Lafollye, read on April 22; M. Yvon states that the reaction then employed was indicated in 1859 by M. Buignet, points out certain inaccuracies in M. Lafollye's paper, and describes a process of his own.—M. Wurtz presented a note by MM. C. Girard and G. de Laire on the formation of diphenylamine with reference to a recent note by MM. Dusart and Bardy.—M. Arrez forwarded a letter relating to his process of treating vines attacked by *Phylloxera vastatrix*, and upon this M. Dumas made some remarks.—Prof. Milne-Edwards presented a note by M. A. F. Marion on the reproductive organs of *Oria Armandi* Clap.—M. Bouley presented a note by M. S. Arloing on the nature of the blood-globules; and M. C. Robin some investigations by M. P. Bouland on the normal curvatures of the rachis in man and animals.—M. Ziegler presented a paper on a physiological fact observed in leaves of *Drosera*, containing some very curious observations on the effects produced on that plant by albuminoid substances after contact with the human hand.—M. Paul Gervais described the lower jaw of a new species of fossil ape from the lignites of Monte Bamboli in Italy. He regards this animal as forming a new genus standing at the end of the series of anthropomorphous apes after the gorilla and before the baboons and macaques. He gives it the name of *Oreopithecus Bambolii*.—M. Delesse communicated an investigation of the deformations which the French geological formations have undergone.—A note on the granite, sand, and clay with flints of the department of the Seine and Oise, by MM. Potier and Donvillé, was read, as also a paper on the valley of the Vezère, by M. F. Hément. The latter, communicated by M. de Quatrefages, contains accounts of traces of prehistoric man found in the valley.

BERLIN

German Chemical Society, May 13.—Dr. Bulk reported on the action of fuming sulphuric acid on aniline blue. He obtained tri-phenyl-rosaniline, in which four molecules of SO_3H replace four atoms of hydrogen, Nicholson's process yielding conjugated acids with from one to three molecules of SO_3H. Hofmann's violet behaves in a similar way to fuming sulphuric acid.—C. Scheibler stated that Erlenmeyer's observations on the non-existence of Gerhardt's para-thionic acid have been previously made by himself.—C. Rammelsberg has analysed a beautifully crystallised specimen of cast iron, confirming thereby his view that the various commercial grey and white irons are isomorphous mixtures of the pure element with combined carbon, and with non-combined carbon.—Dr. A. W. Hofmann reported on researches made by Dr. Geyger and himself on the action of aniline on azo-diphenyl-diamine $(N_3(C_6H_5)_2H)$ namely:— $C_{12}H_{11}N_3 + C_6H_7N = C_{18}H_{15}N_3 + NH_3$. The body, violet and soluble in alcohol, combines with one atom of HCl. Its formation and constitution correspond to the magdala red which has been obtained through the action of naphthyl-amine on azo-dinaphthyl-diamine. The body has the same composition as violaniline, obtained by oxydising pure aniline, when three molecules are condensed into one by losing six atoms of hydrogen. Azo-toluyl-diamine, $N_3(C_7H_7)_2H$, treated with aniline, gives rise to an analogous compound, having most likely the composition of rosaniline, $C_{20}H_{19}N_3$, from which it seems, however, to differ. A colouring matter recently offered in the trade, under the name of saffranine (mixed with large quantities of carbonate of lime), dissolving with a yellowish red in water, with a violet colour in concentrated hydrochloric, with a green colour in concentrated sulphuric acid, has been obtained in a similar manner; a mixture of aniline and toluidine being exposed to the action of nitrous acid and afterwards oxydised. Its chloride contains $C_{20}H_{20}N_4HCl$, the formula of which corresponds in appearance to a salt of amido-rosaniline, although its constitution is most likely very different. Perkins' analyses of mauveine agree with the formula of phenylated saffranine, $C_{26}H_{24}N_4$; and some of its reactions, notably its behaviour to hydrochloric and sulphuric acid, coincide with this suggestion, these acids producing violet and green colours as with saffranine. But it is not easy to understand how the fourth atom of nitrogen should enter into mauveine under the ordinary conditions of its formation.—Th. Peterssen published the analysis of a metasilicate of sodium, $Na_2SiO_3 + 5$ aq.—Barl and Hübner found that nitrobenzol and similar substances form hydrocyanic acid when fused with potash. A similar observation has been published by Wöhler in 1828.—Geromont has obtained isobutyric acid from bibromo-pyrotartaric acid.—Michaelis found PCl_3Bo_2 to form unstable combinations with Br_2 and Br_4, comparable to the addition of water of crystallisation to a saturated compound.

BOOKS RECEIVED

ENGLISH.—Conversations on Natural Philosophy, 14th edition: Mrs. Marcet (Longmans).—The Geometry of Conics, Part I.: C. Taylor (Deighton and Bell).—Esse and Posse, a comparison of Divine eternal laws and powers: H. T. Braithwaite (Longmans).

FOREIGN.—Deutscher Universitäts Kalender für das Sommer-Semester, 1872: Dr. F. Ascherson, Berlin.—Sonnensystems: Meibauer.

DIARY

THURSDAY, MAY 23.

ROYAL INSTITUTION, at 3.—On Heat and Light: Prof. Tyndall, F.R.S.
LONDON INSTITUTION, at 7.30.—On the Artificial Formation of Alcohols from their Elements: Prof. H. E. Armstrong.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—On Babbage's Calculating Machines: Prof. Clifford.
LINNEAN SOCIETY, at 3 p.m.—Anniversary Meeting.
VICTORIA INSTITUTE, at 4 p.m.—Anniversary Meeting.
QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, MAY 25.

ROYAL INSTITUTION, at 3.—On the Chemical Action of Light: Prof. Roscoe, F.R.S.
GOVERNMENT SCHOOL OF MINES, at 8.—On Geology: Dr. Cobbold, F.R.S.

MONDAY, MAY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 1 p.m.—Anniversary Meeting.
LONDON INSTITUTION, at 4.—On Elementary Botany: Prof. Bentley.

TUESDAY, MAY 28.

ROYAL INSTITUTION, at 3.—On Development of Belief and Custom: E. B. Tylor.

WEDNESDAY, MAY 29.

ROYAL SOCIETY OF LITERATURE, at 8.30.—On the Province of Conjecture in Literary Criticism: Dr. C. M. Ingleby.

THURSDAY, MAY 30.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
ROYAL INSTITUTION, at 3.—On Heat and Light: Prof. Tyndall, F.R.S.
LONDON INSTITUTION, at 7.30.—Experimental Evidence against the Spontaneous Generation of Living Things: W. N. Hartley, F.C.S.

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